THE TELEGRAPHIC JOURNAL AND

# ELECTRICAL REVIEW.

VOL. XXVII. NOVEMBER 28, 1890. No. 679.

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## THE ELECTRO-DEPOSITION OF COPPER.

WE call the attention of our readers to the letter from Mr. W. Stepney Rawson, which appears in our correspondence columns.

Mr. Rawson says the eight points in his letter published in our issue of November 7th "remain unanswered," and so he favours us with them all over again. To this we have to say that points 1, 2, and 3 consisted of the respective phrases "practically ridiculous," "equally ridiculous," and "like absurdity." These points were not "answered," though they were not neglected to be noticed. Points 4, 5, 6, 7 and 8 were all dealt with in their order. When Mr. Rawson gives us something other than absurdities and unsupported denunciations we can deal with it, and in his letter which we publish to-day Mr. Rawson does give us something tangible on the first point, which also bears on the second and third. In the calculations which we published on October 17th we allowed for a week of 60 hours, which is a very general basis to take for a week's work. Whether working a larger number of hours is a more economical plan depends largely on the relative importance of labour and plant. There is nothing incorrect about the figures we gave. Contrary to the Elmore plan, we stated clearly and definitely the basis of our calculations, and expressly emphasised their hypothetical character by following them with other data derived from actual work. Mr. Rawson says we should have taken 156 hours. Experience in other cases supports his contention for a larger number of hours per week, and when we make further calculations we will adopt a larger number. If Mr. Rawson will also favour us with his views of the number of tanks which should be taken into consideration, and we find that equally reasonable, we will adopt it, too, together with the further modifications which would then be necessary to arrive at a correct result. He knows well enough, however, that we were not labouring under the impression that Elmore uses one tank only.

In the calculation referred to we arrived at a figure of 287,620 ampères. Mr. Rawson says these figures are absurd, and should be corrected to 3,000 ampères. Now if these two sets of figures are intended to represent the same thing, it is only necessary to place them in juxtaposition to show there is an absurdity somewhere. What our figures mean, and how they are arrived at, are clearly set forth in every detail. If Mr. Rawson will tell us what his figures mean, and how they are arrived at in similar detail, the absurdity may become apparent. Without attempting to prophesy we think we may say that the probability is the absurdity will be found not in either of the figures but in their comparison. We may here quote for Mr. Rawson's benefit a paragraph in the same article :—"Placing a number of depositing tanks in series would not make matters any better, for what is gained in one respect is lost in another."

These remarks cover Mr. Rawson's first, second, and third points. The fourth point contains a new claim to economy in the Elmore process by the reduced size of tanks necessary. We have no wish whatever to minimise this, or any other, advantage, and if Mr. Rawson will also favour us with particulars of the extent of this economy, we shall be much obliged to him. We have nothing to add to our remarks on horse-power, which is the fifth point. On the sixth point, we have only to say, in addition to what we have said already, that the age of our £12 data is immaterial. Moreover, the Norddeutsche Affinerie, of Hamburg, whose figures, it will be remembered, were the lowest of those quoted on p. 479, and to whom we applied for verification, sends us the following ominous reply :—"We beg to say that the figures in question are incorrect, but we are not willing to rectify them." Reductions, if any, apply generally, and whether £12 or £8 be correct, the Elmore Company will have to deal with the market price, and the market price will be dependent upon competition. The simple

questions are: (*a*) Can electro-deposited copper compete with copper otherwise prepared, for use under circumstances in which electro-deposition is an unnecessary refinement, or (*b*) in cases where electro-refining or depositing is advantageous, are the economies of the Elmore process such as will enable the company to undersell everybody else in the market, and still pay a dividend on the purchase price of the patents? The further question of the protection afforded by the said patents is, of course, very material, though in a different category. On the seventh point, we must ask Mr. Rawson not to make too much of our disclaiming any intention to reflect upon the quality of the articles produced. We did so simply in accordance with our usual custom not to express an opinion without due consideration. It will be time enough to commend or condemn the quality of the articles when they are in the market. The eighth point brings us to the report of Mons. Secretan, with which we consider it necessary to deal somewhat fully. Before we do so, we may remind Mr. Rawson that we have been through his points, number by number. If there is still something we have left unsaid, he will doubtless remind us of it. In such an event, may we suggest to him that in controversial discussions there is some danger of losing sight of the main point by enlarging on side issues. We have no intention of permitting this to be done if we can avoid it. Therefore, perhaps Mr. Rawson, in any future communication, will bear in mind that the questions of real importance are those we have asked in reference to point six.

The report of Mons. Secretan, as presented to his directors, contained a statement of the cost of production, and the prices to be realised. This would have helped materially to the elucidation of the questions we have propounded, but unfortunately it is represented in our copy by an asterisk and a footnote. But sufficient remains to enable us to form an idea of its value.

Mons. Secretan, accompanied by two gentlemen holding official positions, and others who are described as very able technical men, but are unnamed, went to the factory at Leeds to inspect it, and to make themselves acquainted with the Elmore process and its cost. Some figures were given them (they have not been sent to us), and they were able to satisfy themselves that those figures were perfectly exact.

The statement represented by the asterisk is prepared on the supposition of an output of 900 tons per month—which could be reached in a very short time. The expenses are taken at a maximum—nothing on earth can make them heavier, whilst it is only necessary to prepare a definite project and they are at once reducible. The statement was not so thorough as it might have been, since some articles sold at high prices but cheaply made are omitted from it, and have to be specially mentioned in the report. No hint is given as to the nature of these articles. They may be *articles de vertu*, or they may be *articles de cuisine*. In his pre-Elmore days Mons. Secretan was famous both for his art collection and his hospitality, so both may have been in his mind. Mons. Secretan has rapidly acquired the true Elmore manner for, having made a series of statements, they become "well established," and work must be commenced forthwith. The statement having been prepared on a basis of 900 tons, Mons. Secretan concludes that the directors may find it more prudent to arrange for an output of 300 tons. We are tempted to ask whether a profit does not, to some extent depend upon the extent of output, and whether the brilliant result doubtless foreshadowed in the statement is equally applicable to an output of exactly one third? The report concludes with the remark that manufacture being once decided upon, one can, without rashness, predict a brilliant future for the company, and instances itself (the report) in another characteristic Elmore touch as a justification of the heading of the prospectus "a revolution," &c.

This is the report which Mr. Stepney Rawson sends us in confirmation of his statement that competent authorities have verified the correctness of the statements made as to the cost and quality of the articles manufactured. This is the report to act upon which the Directors pledged the whole substance of the company for a loan of £50,000.

Had Mr. Rawson permitted the statements to have remained without this confirmation, the statements would have been more generally credited. Had the directors not acted upon the recommendations of such a document they would have had so much the less to answer for.

So long as the Elmore Company have an undoubted right to withhold information, and exercise it, they must expect people to form impressions upon the material open to them. In businesses conducted in a business-like way, enquiries as to cost of manufacture are seldom indulged in and less seldom conceded. The Elmore business is not conducted in such a manner. From first to last the proceedings have been such as to give but one impression, which we will express in plain English as absolute distrust.

We are concerned for the possible waste of money, as we have said before. The borrowed £50,000 and the balance remaining to the company after payment of the purchase money, are not yet spent. Are there none of the directors who can see the wisdom of waiting until the English factory pays its way before starting a French one? Is there not one shareholder sensible enough to realise that loss of time is better than loss of money, and protest accordingly?

The directors should remember that they will not always have an undoubted right to withhold information from everybody. A time will come when they will have to render an account of their stewardship. When the time does come, if the account be unsatisfactory, stock phrases at the shareholders' meetings will not avail them much. They cannot say that the possibilities of adverse results have not been put fully and fairly before them.

Notwithstanding the risk we run of having some indignant shareholder complain of the number of our columns devoted to the subject, there are two other phases of the Elmore question which we should like

to touch upon. Mr. William Elmore has written to the newspapers to explain that the fall in the price of the shares is due to the recent financial crisis, and the realisations of weak holders. Mr. Elmore will find a more reasonable explanation in our columns. On October 3rd, we wrote that the public should clearly understand that the price of Elmore shares is simply a measure of the reliance of the holders on the absorption of more sub-companies. The same remarks apply now. The change in price is the change in the reliance of the holders.

The other phase is the "Trust." Now a trust may be formed for one of two reasons—or a combination of both: to obtain more cash from the public, or to concentrate voting power in the inner circle. The only one of these which concerns us is the first, and we think there is now little risk of its being operative. The public can understand that inasmuch as two blacks do not make a white, neither do four insecurities constitute a security.

## UNDERGROUND SUBWAYS.

SOME time ago a Bill was promoted in Parliament to authorise the construction in London of a subway in which all underground pipes, and particularly gas and water mains and electric light cables, should be laid. The Bill, which was not formulated in a judicious manner, was strongly opposed by the gas, water, and electric light companies, and was ultimately thrown out. This result has, however, not discouraged the metropolitan local authorities. The members of the Strand Board of Works are uniting with those of other districts in drawing up a memorial to be presented to the London County Council, asking that a Bill should be introduced in the next session of Parliament to authorise the construction of a subway to contain all underground pipes, and thus prevent the present method of indiscriminate laying adopted by the various companies.

That the time will eventually arrive when some kind of subway, or subways, will be necessary in the metropolis for the accommodation of the various pipes and conduits there can be little doubt, but at present, and probably for some time to come, there does not appear to be any such necessity. If, indeed, the same conditions prevailed here as now obtain in New York, the companies concerned would possibly appreciate an efficient subway or subways, provided, of course, they were not required to contribute towards the cost which, to say the least, would be enormous. The *Engineering News*, of New York, gives in its issue of the 1st inst., a page plan of the pipes, conduits, &c., at the intersection of Broadway and Fulton Streets, New York City, prepared from a survey and drawing made by order of the Commissioner of Public Works. The plan shows what is termed the "Broadway Underground Tangle," or, in other words, a labyrinth of gas and water mains, sewers, Edison conduits, electric subways, electric subway vaults, electric subway air pipes, Commercial Cable Company's conduit and vault, pneumatic tube boxes, Steam Company's conduits, steam expansion joint vaults, return pipes, cellar vaults, together with manholes, gas and water stop-cocks, receiving basins, &c. This medley of pipes and conduits is being aggravated by the continual undergrounding of electric light cables, which were formerly carried overhead in the American "happy-go-lucky" fashion. This system of indiscriminately placing below ground all kinds of pipes has, indeed, not been without effect. Explosions, due to various causes, have been the order of the day, and even now frequently occur, although very little is heard of them—possibly because "use is second nature." These explosions are due to a variety of causes. The escape of steam from the steam pipes has deteriorated—and continues to deteriorate—the insulation of the electric light mains leading to the formation of short circuits, and the escape of gas from the gas mains has then come to the fore, with the inevitable result of a nice little blow up. The dropping of lighted matches down manholes has also contributed its share towards destruction, whilst sewer gas has likewise given its assistance.

Surveys are at present being made of underground Broadway, and the cross sections already taken show gas and water mains, the latter up to 36 inches in diameter, crossing and recrossing the street without any apparent cause, in the case of the gas mains, whilst electric subways and conduits, pneumatic tubes and steam heating pipes interlace with each other, and twist about sewer manholes and over cross town sewers in an utterly lawless and incomprehensible manner. This deplorable state of affairs, in this and other streets in New York City, will, however, probably be changed, and some kind of subways will be built to enclose the various systems of pipes.

Fortunately, with the exception of the Strand, along which probably more traffic is carried daily than on any other thoroughfare in the world, London streets are tolerably free from a confusion of underground pipes. Nevertheless, considerable difficulties have arisen in many other streets, owing to the lack of sufficient space to lay electric light conduits either at a sufficient depth, or in the most convenient spot desired by the companies. The proposed Bill would, if it passed through both Houses, provide for the construction of a subway which would contain all the systems of pipes and conduits—an ideal of perfection, according to the promoters. There are, however, many difficulties in the way of bringing such a scheme to a successful issue. In the first place, the cost of making the subway would entail an enormous expense—probably several millions sterling—and who would pay the piper? The money would hardly be raised on loan by the London County Council, for, if so, the companies interested would, on the completion of the work, be called upon to pay a rental for utilising the subway, and this would amount to a not inconsiderable item in the cost of production, which, correctly defined, is that sum which remains after *all expenses* have been deducted. Provided that the County Council did not raise the money, an attempt might be made to get a clause inserted in the

Bill to compel the gas, water, and electric light companies themselves to construct the subway, since it would be built for their convenience—oh, no—for their use. That such a clause could be passed seems incredible. The companies are already strongly represented in Parliament indirectly, and, with the assistance of other members, it is fair to assume that such an objectionable clause would be rejected.

The proposed subway would during the course of construction not only cause considerable interruption in the supply of water, gas and electric light, thus entailing great loss to the companies, but it would also necessitate the reorganisation of the three systems of distribution, another item of great expense. Again, if a subway is to be made, the question arises as to the kind of subway to be constructed, but this need not be referred to in detail. Suffice it to say, that if a subway is to be built, the gas, water and electric light mains must not be placed therein after the haphazard style adopted in Paris or in New York. The ideal subway appears to be one arranged in divisions, each being distinct from one another, and each being water and air tight. As to the raising of the money, this matter had better be left for the consideration of those long-headed individuals who have plenty of spare time, and scarcely anything to do but inconvenience public companies and spend ratepayers' money.

"Necessity is the mother of invention," and when the time arrives for the construction of a subway, necessity will show itself in the elaboration of a suitable subway. At present, however, there is no such need, and the proposed Bill, if it assumes definite form, will doubtless meet the fate of its predecessor.

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**The Properties of Alternating Currents.**

THE Boston Electric Club held its first meeting of the season on the 10th inst. Professor Elihu Thomson delivered the inaugural address, choosing for his subject "The Properties of Alternating Currents," and illustrating his lecture with numerous experiments. The Professor said that the alternating current had been experimented on with alternations as high as 8,000 per second. What was really needed was a machine to produce 500 trillions of vibrations per second, from which some wonderful results might be expected. He then described the general properties connected with the alternating current, and to demonstrate his statements he had a powerful coil placed on end on a stand, and secured to a wooden upright, to which he attached first one device and then another, as he required. The coil was excited by an alternating current, a copper ring, about six inches in diameter and three-eighths thick, was held in the air above the top of the coil, and by induction the ring was held in mid air. Another ring then placed below the first, clung to it by magnetic force. The rings either floated or jumped about according to the angle the rings made with the coil. A copper hollow ball, placed on a plate just above the coil, began to rotate, but was speedily stopped by introducing a sheet of copper between the plate and the head of the energised coil. A pivotted copper disc revolved rapidly when brought near the coil, its direction in running depending on its position in regard to the coil. To prove the principle on which incandescent lamps are operated by an induced current, a glass jar of water was placed over the coil; submerged in the water was a coil, to which was attached an incandescent lamp, which burned brilliantly. By simply raising the jar the intensity of the light produced was regulated in a most perfect manner, the lecturer saying there was no longer any truth in the assertion that the electric light could not be raised or lowered. A jar of water being held over the coil, into which was dropped a hollow copper ball, the ball commenced to rotate. Professor Thomson also showed some experiments in electric welding, and a device somewhat similar to a gyroscopic top. The final experiment was extremely interesting. A small motor, consisting of a circular coil, being fixed horizontally with a slot cut through one side, a pivotted disc working in or close to the slot rotated rapidly when the current was turned on. Removing the disc the machine became a counterfeit coin detector, for it possessed this remarkable characteristic that if a genuine silver coin was placed near the slot it would be drawn into the vortex, as it were, and instantly flung out on top of the coil while a counterfeit coin would not be in the least affected.

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**The American Eagle on the Wing.**

The *Boston Herald*, of November 5th, contains what is apparently the reproduction of an article written in the *New York Sun* under the somewhat alarming title of "A Source of Danger." Fearful as to what fresh perils awaited unfortunate humanity, we read, and trembled. Imagine then our relief when we found that it was only our old friend electric lighting again to the fore, or let us say, at sea, for the sub-title of the article in question is "Improper Electric Wiring of Ocean Steamers on the English Plan." We are told that the *Etruria*, on a recent passage across the Atlantic, was on two occasions threatened with fire, owing to the imperfect insulation of the electric light wires, and we alluded to this matter in a Note (p. 368), as also did Mr. Rankin Kennedy in our correspondence columns (see REVIEW for October 3rd), in a letter which might be again read with advantage. Horror struck at the thought of the frightful catastrophe which might have attended the fires which nearly occurred, we read on, hoping to find some brilliant suggestion for the prevention of this source of danger. And we found it—an advertisement of Edison plant. But let us give the article full justice. The case of the *Etruria* serves as a *raison d'être* for instituting a comparison between the American and English methods of ship-wiring. Needless to remark, it is not our cousins who suffer in the contrast. We are informed that ship installations on the English plan have not sufficient safety fuses, that the insulation of the wires is imperfect, and that the employment of the hull as a return circuit is not only an inefficient, but absolutely dangerous plan. It will be of interest to English electric lighting engineers to learn that the two-wire, or metallic circuit, is the "American" method. Nor is it of any less advantage to realise that this is the particular system in which the copper wires are carefully insulated with "a material," then drawn through lead pipes, and finally let into a heavy moulding. Let English engineers take heed to this note of warning. It is only a matter of time until the "criminally dangerous system" adopted by them in ship wiring must give way to the "vastly superior" American method; at least, so says the *Sun*.

Subway Explosions.

THE repeated and alarming explosions which have occurred in the street junction boxes of the Newcastle Electric Supply Company, which, besides causing considerable derangement of the flagging, have occasioned slight injury to several persons, have been attributed to leakage of gas; but as the explosions have taken place during or after rain, and the boxes are by no means wet proof, it is at least open to doubt whether the true explanation is not the formation of hydrogen owing to the 2,000 volt alternating current leaking between the bare uninsulated connectors that are employed for joining the mains, through water in the boxes, which hydrogen, being mixed with air previously in the box, is fired by a spark, resulting on the level of the water becoming depressed, and the contact being thereby broken. In any case, that explosions can be originated in this manner is capable of experimental proof. It is only fair to the other electric lighting company in Newcastle—the Newcastle and District Electric Lighting Company—who have now an equivalent of 7,000 10-C.P. lamps coupled to their mains, to mention that no accident of this kind has occurred in connection with their service since starting in January last. This company's junction boxes being of cast iron, with screw-down lids, are quite water-tight, and the joints in the cables being all insulated with India-rubber vulcanised *in situ*, it is difficult to imagine how in their case any explosion could by any possibility take place.

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The Electric Light on Ship-Board.

THE Institute of London Underwriters, stimulated by the appeal of Mr. Leonard Wakefield, of Lloyd's, is endeavouring to have the system of electric lighting at sea set at once upon a more satisfactory footing. Lloyd's Register of British and Foreign Shipping, better known as "The Book Committee," were requested to indicate in their Register every instance in which a vessel is lighted by electricity, and to bring electrical installations under their rules of survey, and the engineer surveyors of the Book have drawn up and submitted a practical report, concluding with a scheme of regulations for adoption by the committee. The dangers involved by the use of the electric light on board ship are, says the report, of two kinds. First, the dynamos themselves, and the electric currents in the cables, have an influence on the ship's compasses; and, next, there is the more obvious danger of fire. In order to minimise the first risk, it is recommended that dynamos and electric motors be placed as far as possible from the compasses. Where the single-wire system is used, and the ship itself is made a medium for the return current, the compass is in danger of being deflected. By resorting to the double-wire system, the return current can be so carried past the compass in the reverse direction as to counteract the influence of the main wire. This system, therefore, is encouraged by the engineers. Where, however, the single-wire plan is, notwithstanding, followed, then the committee are advised that the distance between the wire and the compass should in no case be less than 15 feet. It is recommended that special precaution be taken to test the compasses whilst the dynamos are working at their full capacity, and the same tests be applied whilst the groups of lights are switched in and out. With respect to the fire risks, they are more multifarious. Great care should be taken to secure a perfect insulation of the wires, not merely of a high initial resistance, but one which will be permanent. The conditions of non-conductivity on shore and at sea are different things. An insulation, which may be permanent enough on dry land, may fail to hold out against conditions maritime—against the changes of temperature, the moisture of the salt water incidental to transit at sea. The recommendations of the report as regards the effective insulation of wires and cables are of great value, and the electricians have further called attention to the fact that methods of protection which may be good enough in some parts of the ship may require supplementing in parts where the risks arising from rough usage or heat are more considerable. Special advice is given as to the safeguarding of joints and junctions against the effects of moisture. To safety fuses, also, close attention is recommended. But the "cut-out" is no protection against the consequences of thinning of the wire by corrosion, or against a break caused, for example, by a too taut setting of the wire. These dangers can only be prevented by careful attention to the work throughout. In petroleum vessels, a special danger has to be provided against; for, an incident of the carriage of petroleum is the accumulation in certain localities of an inflammable vapour, which, it is believed, is liable to be ignited by the electric spark. On vessels which had been recently discharged of their petroleum, heavy accumulations of explosive vapour are especially to be feared. The switches on oil-carrying vessels should, it is urged, always be placed above the upper deck, in the open air, or in places removed from possible gaseous accumulations; and other suggestions are made by the electricians to similar purport.

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The Telephone in Competition.

FOR the past eleven years a highly successful telephone exchange, conducted by a local company, has been in existence in Sheffield, and during the latter portion of that time the National Telephone Company has also had an exchange in the same town. As the expiration of telephone patents approaches, the competition between these companies grows more keen, and the rates that are now being charged in Sheffield may, in all probability, be taken as an indication of the rates that will obtain in all other large towns, in the immediate future. The local company recently announced a reduction of rates to £7 per annum, and this was at once followed by a reduction on the part of the National Company to £5 per annum. In view of the arrangements that are rapidly being made to challenge the monopoly of the National Telephone Company in all large centres, by properly constituted companies, it remains to be seen how soon the National Company will still further realise the nature of the coming struggle, and how soon it will meet the same by a general reduction of rates to the level to which it has shown the way in Sheffield. Meanwhile the Sheffield Company is preparing to join hands with the new companies for mutual support, and if inter-town communication is to be a real necessity of future telephonic developments, it may reasonably be anticipated that through wires for the same will readily be provided by the Postmaster-General, and probably on terms that will be less burdensome than those that have been self-imposed by the National Telephone Company.

## ON THE ACTION OF LIGHTNING DURING THE THUNDERSTORMS OF JUNE 6th AND 7th, 1889, AT CRANLEIGH, SURREY.*

By CAPT. J. P. MACLEAR, R.N., F.R.Met.Soc., F.R.G.S.

DURING the thunderstorms of June 6th and 7th, 1889, so many trees were struck within a radius of 4 miles from Cranleigh, that I set to work to discover, if possible, the cause of selection of these particular trees; for, contrary to general expectation, they were not the highest nor the most prominent in their immediate vicinity; and though I cannot say I have solved the question, as the causes of preference appear to be very slight, yet I think I can put forward some interesting facts which may help us to a further knowledge of the nature of the electric discharge, and the course it may be likely to follow.

On June 6th, the storm first appeared to the southward of Cranleigh, about 4.43 p.m., and it passed about 4 miles to the south-west. About 5.30 p.m., shortly before rain commenced, the following objects were struck, apparently about the same time, but as no accurate observations were made as to time, it cannot be determined whether one or several discharges were concerned. On Dunsfold Common, 4 miles south-west of Cranleigh, a cottage was struck, a chimney at the south-east end knocked down, and the register grates on two floors started from their places; a haystack about 100 yards south of the cottage was set on fire, and two poplars 300 yards west of the cottage were struck, each tree having a score down it, 1½ inches width of bark being stripped off. On Hascombe Hill, 1½ miles north of the cottage, and 400 feet above its level, a spruce fir was shivered; at Alfold, 1¾ miles south-east of the cottage, two oaks were struck, one was only scored, but the other was split (this latter tree was struck again and splintered the next day); also three oaks about a mile to the westward of the cottage were struck, but as it is only conjecture that they were struck at the same time, I shall not refer to them again. More trees may have been struck in the neighbourhood, but not noticed.

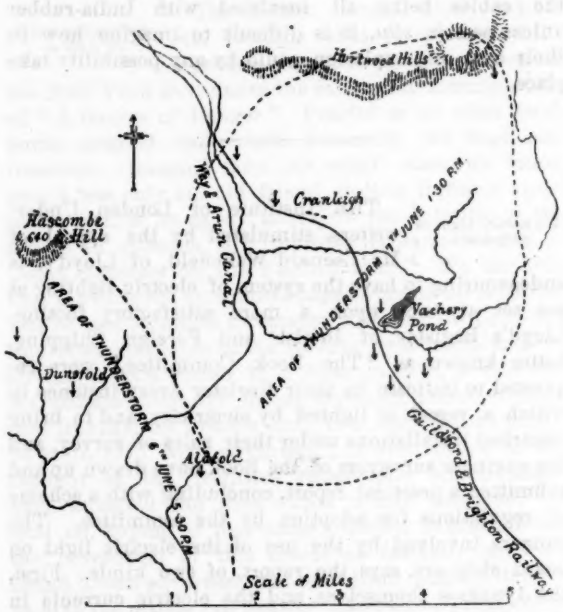
As for the causes of these objects being selected, it will be seen that they lie nearly in a line north-west and south-east, 3 miles in length. Mr. Marriott has shown (*Quarterly Journal*, No. XV., p. 222) that the storm was passing in a north-west direction with a south-east wind; it is possible that the storm was delayed by the high Hascombe hills, and the charged cloud thereby concentrated. The spruce fir was very prominent on the southern brow of the hill; it divided into two arms nearly in line with the stem; one arm was thrown to the ground, the other blown down by the wind a few hours afterwards. At the junction of the arms there was a great deal of turpentine, which was thoroughly blackened. In this case I should consider that the prominence of the tree made it the best communication to earth, and that the collection of turpentine at the juncture of the arms was raised to explosive temperature, and split the tree.

The cottage, haystack and two poplars on Dunsfold Common do not immediately suggest a cause of selection, but from their position the ground falls to the south-east in a wooded valley through which the Arun and Wey canal runs, and on the other side of this wooded valley are the Alfold trees. Streams into the canal run from near all the objects struck, and though I hesitate to advance this point, it is possible that the earth electricity was thus able to collect more readily at these places than at others under the cloud. It would be exceedingly interesting to know if these three objects were all struck by the same discharge.

On June 7th, the storm began with little warning at 1.10 p.m., and was at its height at 1.27, when there fell the heaviest rain known to the oldest inhabitant. About 1 30 p.m. the following objects were struck:—Near Vachery pond, a large reservoir for the Arun and Wey canal, 1¼ mile south-east of Cranleigh, six oaks a chestnut, and an ash, in various positions within ½ mile of the pond and about ¼ of a mile apart, a young fir and three young oaks in the middle of a copse on the slope of the ground near the pond, four oaks ½ a mile south of Cranleigh, one oak on Cranleigh Common, a chimney and stable 1 mile north-west of Cranleigh, besides the oak tree before mentioned at Alford, and a single oak occupying a fairly prominent position on the slope of the high hills 2½ miles to the north-east of Cranleigh. This last tree was struck just before the rain commenced on the hill, and was split; the other trees struck, during the rain, were only scored.

Here the area of discharge extends along a line about three miles in length north-west and south-east, as on the previous day; and with the exception of the Alfold tree before referred to 3 miles to the south-west, and the tree on the hill 3 miles north-east, all the objects struck were scattered along the line of railway, and at no great distance from it.

It is not easy to see the cause of selection, for these trees were not the most prominent nor were they on the highest ground in the vicinity; the only feature the groups possessed in common being that they were all either near ditches which were full of running water, or else near temporary courses taken by the deluge of water from the higher to the lower ground. The most puzzling case is that of the young fir tree and three young oaks in the middle of the copse near




Vachery pond; they were not higher than the other trees in the copse, but there certainly was a temporary water course running close to them; other trees, however, stood equally close to the water, and unless a large squirrel's nest of moss on the top of the young fir be called upon to account for the selection, it still remains obscure. Another curious case is that of the stable struck, which was overshadowed by tall elms, where it might have been supposed that these would have taken the stroke.

Of the species of trees struck, the oak is the most frequent, and I am inclined to believe that the reason is not that there are more oaks than other trees in the neighbourhood, but that the roughness of the bark causes gaps of its continuity as a conductor; elms, firs, poplars and chestnuts have been struck, but it is said that the beech is never struck.* It has been said, also, that oaks are more frequently struck in the spring and other trees in the autumn, but this requires confirmation.

* Read before the Royal Meteorological Society.

* "The Action of Lightning." By Colonel Parnell.

The injuries to the trees are of two kinds: the first, by far the most common, is simply a score out of the bark up the trunk of the tree, out along one limb, and then by perhaps two or three branches to the outer twigs; in some cases portions of the bark are blown off as well. A very good illustration of this effect is found in a paper by the Rev. O. P. Cambridge, "On the Effect of a Flash of Lightning at Bloxworth," April 9th, 1886.* In these cases I imagine that the rain is falling, and one or more streams of water are running down the sides of the tree, forming a conductor which becomes insufficient, at the time of discharge, to carry off all the electricity, and therefore becomes so suddenly converted into steam as to blow out the bark along the line, and if there is communication with the sap by a knot, hole, or other flaw, the sap is also converted into steam and the bark blown off.

The other form is the shattering of the tree, which I imagine to occur when the electricity is insufficiently carried off by the outer surface, and collects at the junction of some main branch with either the stem or with some other branch, where there is perhaps a cavity of water in it, or a collection of moist dead leaves; the tree is then easily rent by the explosion of steam generated. If the tension be very great, and especially if the air round the tree be dry, the sap may be violently exploded, and trunk splintered and shattered as if by dynamite.

Of the trees which I have examined here, the only ones shattered were those struck before the rain fell; the others were scored simply, with bark blown off.

In the case of the stable struck on June 7th, I can only think that the electricity collecting at the top of the overhanging elm tree found a better conductor than the trunk in the hot moist air escaping from the near gable of the stable, and the hot air expanding blew the corner tile off to find a better vent. As to the cottage on Dunsfold Common, struck on June 6th, I can trace no cause for selection; the appearance of the chimneys suggests an explosion of air.

As the result of my examinations I can only say that the causes of selection of objects struck appear too slight to be readily perceptible, or to enable one to say beforehand that such and such an object will probably be struck. It seems that during rain every tree is conducting electricity, and a disruptive discharge takes place where the conductor becomes insufficient. This would depend on the position of the cloud, the amount of foliage on the tree, its condition of moisture, and its connection with running water. Also I may point out, as shown by Prof. O. J. Lodge, that if an upper cloud should discharge to a lower one, the lower one may then discharge to earth violently without regard to any conductors.

It would be desirable if those who have the opportunity of observing objects immediately after they are struck would note the surrounding conditions and proximity to water, and whether, in the case of trees struck during rain, the score is on the side on which the rain beats.

* This paper is in the Library of the Royal Meteorological Society.

## THE HAZELTINE ARC LAMP CARBON SHIELD.

MANY of our readers readily recall the time when arc light carbons were sold at the rate of $1 a dozen and were not even then considered excessive in price. Since those pioneer days, says the New York *Electrical Engineer*, there has been a continual diminution in the price of carbons, but with the enormous increase in the number of arc lamps burning nightly, the total expenditure involved amounts to many hundreds of thousands of dollars annually. It has, therefore, been the aim of many to increase as much as possible the life of the carbon on the one hand, or to increase its illuminating power with the same expenditure of electrical energy. These attempts have resulted in the application of various devices, either mechanical or as ingredients of the carbon itself, but, so far as we are aware, scarcely one of these methods has come into practical use, the pure carbon of to-day being still universally employed. The advent of a simple device by which an actual economy in the operation of the arc lamp is effected will, therefore, be of considerable interest, and for that reason we desire to call the attention of our readers to a simple and effective device of the kind due to Mr. W. B. Hazeltine, Jun., of the Hazeltine Electric Company, of St. Louis. This device, which is illustrated in the accompanying engravings, figs. 1 and 2, consists simply of a sleeve of refractory material, forming a protective shield, or tip, which is freely suspended so as to hang in close proximity to the tip and the upper carbon close to the arc, the suspension device being so arranged that the sleeve is automatically maintained at its proper position near the arc. The effect of this simple arrangement, as has been shown by actual experience, is that the life of the carbon is practically doubled, so that an ordinary eight-hour carbon is able to burn 16 hours without retrimming. The exact action to which the saving in carbon and increase in

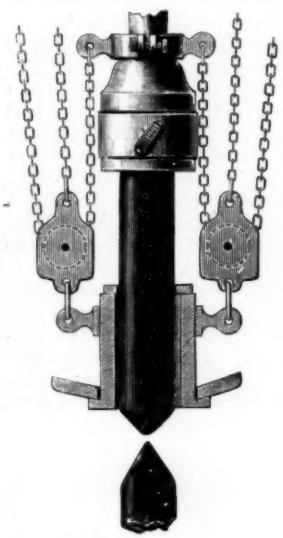


FIG. 1.

FIG. 2

life is due has not yet been fully analysed, the fact remaining, however, as described. The shape of the carbon when protected by the shield is modified somewhat from that usually noted. The economical advantages gained by this device must be apparent. In the first place, not only may a large saving be effected in the carbon bills, but another important item, the cost of trimming lamps, may be reduced in almost the same ratio. A further attribute of the shield consists in the fact that it acts as an automatic cut-out whenever one or the other of the carbons is consumed, thereby preventing the destruction of the carbon holder, it being impossible, of course, for the holders to approach nearer to each other than the length of the shield. Aside from the economy in carbons and trimmer's services, it is pointed out that the convenience to customers of having their lamps trimmed every other day, instead of every day, as at present, will no doubt have the effect of increasing the popularity of the arc lamp. Besides, the consumption of the carbon is so complete that very little carbon dust settles at the bottom of the lamp, so that cleaning may also be deferred to the same time as trimming. We may add that the Hazeltine shield has been tested by Mr. James I. Ayer, superintendent of the Municipal Electric Light and Power Company, St. Louis, operating 3,000 lights, who, after a careful trial, fully corroborates the inventor's claims, which are also attested by the Western Electric Company, in whose factory a similar test was recently made under the supervision of Mr. C. A. Brown.

## THE LINEFF SYSTEM SCORES.

"HURRAH! at last the battle is over and we are victorious. The fighting was severe, but, thank God! we have won the day." These words, which were once uttered by an old English soldier, are peculiarly applicable to the position of the West Metropolitan Tramway Company in relation to the Hammersmith Vestry. It is the old, old story of the opposition of local authorities to electric lighting and traction, and when the local "powers that be" object in such cases, it requires a high *voltage* to induce the Board of Trade to overrule their objections. So much is this the case, that the latter Department almost invariably supports the Vestries, Local Boards, municipalities, &c., which constitute local authorities.

When in an 1887 Session of Parliament the West Metropolitan Tramway Company obtained a special Act authorising the employment of electric traction on the company's lines—about 8¼ miles long—it was thought that electric street traction would assume a definite form in the metropolis. The tramway company and others interested were, however, doomed to disappointment. The local authorities, and particularly the Hammersmith Vestry, now locally notorious as having spent over £1,000 of the ratepayers' money in opposing the granting of the above-mentioned Act, flatly declined to give permission for the use of the Lineff open conduit system which the tramway company had originally intended to lay down. The latter were wise in their generation. The Act did not authorise them to break open the roadways, and as the local authorities were obstinate, the company did not care to experiment with the vagaries of storage battery cars. "Wise men of the west" were, indeed, the directors of the tramway company.

A year passed away, and in that quiet corner of the Chiswick depôt of the tramway company experiments were commenced with a new system of electric traction. These were conducted for some time, until the Lineff closed conduit system became experimentally an accomplished fact. Before the first public demonstration of the system was given, the line was shown in operation to the local authorities.

It was then thought that, as the new system overcame the objections raised against the open conduit method, the local authorities would readily consent to its adoption on the Hammersmith-Kew line, or on that from Young's Corner to Uxbridge Road. Unfortunately, this expectation was not realised.

The Brentford and Chiswick Local Boards gave their permission, but the third local authority concerned—the Hammersmith Vestry—again refused to do so. The tramway company were thus placed in an awkward position. It was either necessary to again apply to Parliament to authorise the breaking up of the roads, or, Micawber-like, to wait "for something to turn up." Pressure—high pressure, of course—was, however, brought to bear upon the vestry, who a few weeks ago resolved to grant permission for the laying down of the magnetic conductor, subject to a favourable report being received from an expert whom they appointed. Favourable reports were received by the vestry from Mr. W. H. Preece, Mr. G. Kapp, and Prof. Robinson, and on the 20th inst. the vestry unanimously agreed to the proposal of the tramway company to work the line from the Uxbridge Road Station to Kew, a distance of three miles, by the Lineff closed conduit system. The work of laying down the magnetic conductor is to be commenced at once. Thus terminates one of the most obstinate battles which have taken place between local authorities and the promoters of electric traction.

It might appear from the foregoing that the blame has been entirely on the part of the Hammersmith Vestry; but it is believed, and has been stated, that the vestry was perfectly justified in opposing for so long the adoption of the Lineff system. Whatever the reasons for this may be, it is satisfactory to find that after a struggle extending over a period of nearly three years, a definite decision has been reached. It only remains to be seen whether, when the system has been laid down, the anticipations of the promoters will be realised. We trust that this will be the case, as it will be the first underground closed conduit system to be shown on a practical working scale.

## COMMUNICATIONS FROM AUSTRIA-HUNGARY.

[FROM A CORRESPONDENT.]

THE Popp Compressed Air Company are making everywhere great efforts to obtain a footing for their system in Austria-Hungary. Last week M. Victor Popp made his appearance in person at Budapest in order to carry on a propaganda for his system in influential quarters and to take steps for obtaining the long-coveted concession for erecting and working a compressed-air central station at Budapest. Unless, however, the indications are untrustworthy, the efforts of the Popp Company will not prove successful at Budapest.

In Vienna the Lower Austrian Trades' Association was concerned last week with the Popp system. 249 Viennese firms, tradesmen and industrialists, have handed in to the council of management of the above association a memorial in which they urge that 1,400 Viennese industrialists have subscribed to the "International Compressed Air and Electric Company" for a total of 17,000 H.P., but that the application for a concession has been under consideration for more than 18 months in the Viennese Municipal Council, therefore the association is besought to take steps for the acceleration of their affairs. The council of management has introduced this memorial to the Municipal Council. The president of the association has personally handed the memorial to the presidency of the Municipal Council, and applied also to the director of the magistracy. From both sides the assurance has been given that now the great question of the union of the city of Vienna with the suburbs, no longer claims all the attention of the council, the affair will be quickly taken in hand and brought to a conclusion. But with what result the future must show.

On the 13th of this month the Vienna central station of the International Electrical Company was set in work with the secondary installations connected. The next day other points were experimentally connected, and as the trials on both evenings gave satisfactory results, the regular working will begin to-day, at first with a capacity of 2,000 H.P., with successive extensions up to 10,000 H.P.

Herewith the total cable net of the company which at present branches out for the length of about 33 kilometres and is laid down in various wards of the city will be set in action. The Imperial Palace will be among the objects illuminated.

At the central station of the Brush Company at Temesvar there occurred on the 14th inst., a very deplorable misfortune. About 5.30 p.m., just as the machines for lighting the streets (Brush continuous current dynamos) were set in action the main driving band got in irregular vibration. The attendant on the dynamos and the foreman rushed up with spreading rods to prevent the band from slipping when a whitesmith, who had been employed in the installation for about four weeks, a man of 24 years of age, named Franz Schneider, ran to the dynamo to disconnect the brushes. Schneider was not authorised to do this, but wished, doubtless to show his willingness, to his own misfortune. Instead of laying hold of the caoutchouc handle he seized the brushes with both hands. The entire current of 2,000 volts passed through his body. He was dead in a moment and had to be dragged away by violence. This misfortune occasioned an irregularity in the lighting. The director Clements instantly sent for physicians, but all attempts to restore animation were fruitless.

According to a report of the Hungarian Ministry of Trade, there were in Hungary in the year 1889

altogether 10 municipal central telephone stations in work with the following result :—

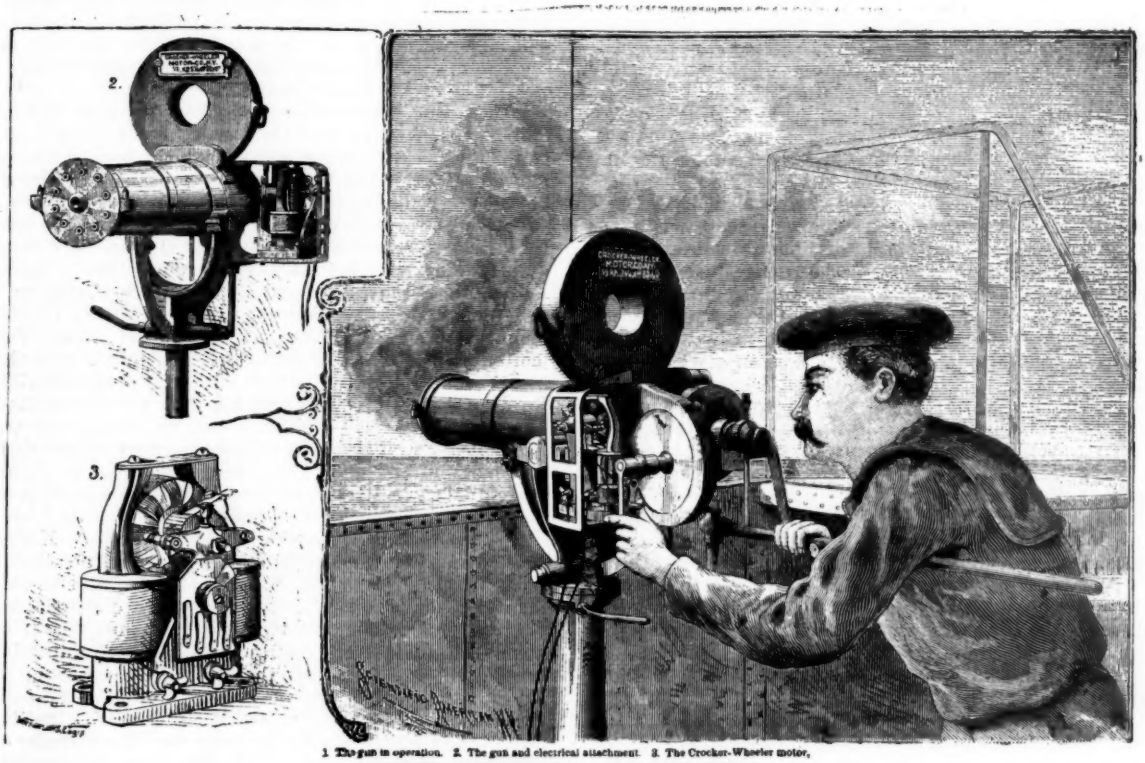
| Name of Town. | Subscription monthly. | Number of Subscribers. | | |
|---|---|---|---|---|
| | | 1887. | 1888. | 1889. |
| Budapest ... ... | 12½ florins* | 933 | 1,081 | 1,193 |
| Szegedin ... ... | 9 „ ** | 62 | 69 | 56 |
| Arad ... ... ... | 9 „ ** | 20 | 17 | 23 |
| Temesvár ... .. | 8 „ ** | 88 | 87 | 86 |
| Pressburg ... ... | 7 „ *** | 68 | 76 | 77 |
| Füsfkirchen ... ... | 9 „ ** | 54 | 57 | 48 |
| Agram ... .. | 7 „ * | 72 | 68 | 89 |
| Grosswardein ... | 7 „ * | ... | 68 | 88 |
| Debrezin ... ... | 6 „ * | ... | 65 | 78 |
| Miskdez ... ... | 8 „ * | ... | ... | 28 |

* Without regard to distance.
** Up to 2 kilometres distance; another florin for each additional kilometre.
*** Up to 1 kilometre.

adds a second disturbing element to the vibration due to the recoil.

The Crocker-Wheeler Motor Company, of this city, were invited by the the United States Navy Department to arrange an electric firing mechanism for the Gatling gun. Several requirements had to be kept in mind in producing the design. The apparatus had to be attached to the barrel of the gun, so as to move with it. It had to be out of the sighting line, and it was necessary to dispose of it so as not to interfere with elevation or depression of the gun. The motor finally had to be adapted for operation by the electric lighting plants as installed upon the ships of war. The drawings show clearly how the problem has been attacked.

Upon the left hand side of the breech of the gun an open frame of generally rectangular outline is secured. Within it is placed the motor. This is a specially-wound motor, adapted for an electromotive force of 80 volts, and a current of 3 to 3½ ampères intensity. This, it will be seen, represents the absorption of a



1. The gun in operation. 2. The gun and electrical attachment. 3. The Crocker-Wheeler motor.

FIRING GATLING GUNS BY ELECTRICITY.

## ELECTRICALLY-FIRED GATLING GUN.

THE above illustration from the *Scientific American*, shows a new application of the electric motor, in which it is caused to operate a Gatling gun. This well-known type of mitrailleuse has been placed on many of the United States naval vessels, and represents a very powerful weapon for repelling attacks and for general fighting work at close quarters.

Hitherto the Gatling gun has not been automatic. The loading is effected by turning a crank attached to the breech mechanism of the piece. As this causes the barrels to rotate, they are are discharged one at a time. Ten barrels are comprised in the piece, so that for each revolution 10 shots are delivered. While one man turns the crank, a second man, holding the tail stock or lever, may be employed in directing and aiming the piece, if continual change of direction is needed. While this character of manipulation is often required, and is that by which rapid-firing guns should perform the greatest execution, it has attendant difficulties. The turning of the crank inevitably causes the piece to oscillate, and

little over one-third electric horse-power. The efficiency of the motor is placed at over 80 per cent. The spindle of the armature, which in general terms runs horizontally and at right angles to the axis of the gun, carries a pinion which engages a large gear wheel. The latter is enclosed in the cylindrical or disk-like case, which is seen next to the motor by the side of the breech. The spindle of the large gear wheel is prolonged across the end of the gun barrel, and carries a worm at its end. This gears into a worm wheel on the working spindle of the gun.

This double reduction of speed causes the operation of the gun at about 150 revolutions per minute, giving 1,500 discharges. This rate is rather high for general practice, and can be considerably reduced.

A small switch is provided for turning the current on and off. The artillerist, after starting the motor, is free to swing the piece in any direction. This he can do without interference from a second operator, and the gun is undisturbed by the shaking due to the turning of the crank.

Between the motor and the large gear wheel is a clutch, by which the motor can be connected or disconnected from the breech mechanism. The crank by

which the piece is worked by hand under the former conditions, is arranged for rapid disconnection or reconnection. This provides for injury to the electric apparatus. If the latter becomes disabled, or if its connections are severed, the clutch can be thrown open and the handle connected, when the gun will be ready for operation by hand. This change takes only a few seconds. This application of electricity is of special interest, as bringing the Gatling gun into the rank of automatically fired artillery.

## POSTAL TELEGRAPH CLERKS AND THE "QUIN TESTIMONIAL."

A CELEBRATION somewhat on the lines of the now familiar Postal Jubilee ceremonial has to be noticed during the past week, when the Postmaster-General, in what a contemporary terms the "happiest of veins," contributed a not uninteresting speech on the subject of the wonderful spread of postal and telegraphic business in Great Britain during the last 20 years.

The laying of the memorial stone of the vast building in Aldersgate Street, henceforth to be known as the General Post Office North, and which will, it is expected, be finished in 1893, brought together a crowd of officially sympathetic and officially enthusiastic supporters of the Postmaster-General.

Doubtless much complacency distinguished the bearing of those fortunate individuals present who were referred to as the recipients of honours conferred on them by Her Most Gracious Majesty the Queen, and in the eyes of those whom curiosity, if no stronger motive, had attracted to the spot, they would be regarded possibly with feelings not unmixed with awe.

With regard to the matter of honours, while such things as C.B.'s, K.C.B.'s, and G.C.B.'s remain symbolical of the expressions of a sovereign's, and perhaps a nation's favour, it may be well to remind those who in civil capacities have been fortunate enough to secure a place in the struggle for social distinction that much of that distinction, especially in the Civil Service, is due to the ever-increasing labour and responsibility thrust upon those who have to battle for a bare existence, many degrees lower down in the social scale. Military and naval men, as a rule, do not forget that their "ribbon, stars, and a' that," are in a great measure the recognition of the concentrated efforts of phalanxes of their fellow-countrymen, and this is equally applicable to the numerous army of civil servants.

In this direction few probably of the complacent and successful hearers of the Postmaster-General's speech troubled themselves, and no thoughts of the discreditable labour turmoils of the postal administration, which will render the year 1890 famous, were visible on their smiling countenances.

Interested as scientific men are generally in the progress of telegraphy and its practical application to commerce, the amazing progress of the Postal Telegraph Service, and the ever-increasing assimilation of its advantages to the general interests of the community at large, may well occasion them surprise. It seems tolerably certain that the Telegraph Service, given fair opportunities, will outstrip the sister services; the statistics quoted by the Postmaster-General, indicating a greater percentage of increase of public patronage than is shown by the other services referred to by him.

The growth of the Central Telegraph Department alone since 1870 is, indeed, a revelation, and it has been asked, and not without reason, why the able and invaluable labours of the veteran chief, or Controller, have not received decorative recognition. Perhaps this honour is withheld through the agitation which exists in the Telegraph Service, and the failure to raise three spontaneous Jubilee cheers on a recent occasion.

While the memorial stone display was taking place in the chaotic wilds of the General Post Office North, a display of another nature was being made in the windows of a well-known City photographer, not 100 yards from the General Post Office, and the peculiar character of the latter display formed the subject of articles in several of the evening papers.

Readers of this journal, who have seen articles on the agitation in the Postal Telegraph Service in these columns, may remember the case of a telegraph clerk named Quin, who was dismissed for "talking on the wire," a breach of minor rules, no doubt, but hardly one necessitating such severe and unprecedented punishment. The unanimous feeling amongst telegraph clerks appears to be that Quin—an executive committee man, and appointed to that position almost against his will by the staff at the Central Telegraph Department—was made a modern, and no doubt, in their opinion, an altogether unnecessary edition of the Israelitish scapegoat, which had to bear the responsibility of a nation's iniquity. As has already been said in these columns, of admittedly irreproachable official character—as well as socially unblemished in that respect, for there is a double distinction here—intelligent, honourable, and honest, Quin's efforts, which largely helped to improve the already comfortable affluence of those who afterwards sat in judgment on him, as well as helping to secure concessions to the staff, only brought to himself censure and dismissal.

It can easily be understood that popular feeling quickly determined that Quin should not go into the world to start life afresh and empty-handed. Though it has been said that "the herd of mankind can hardly be said to think," and that "their notions are almost all adoptive," such does not appear to have been the case in the matter under notice. Subscription lists were quietly but expeditiously sent round the Central Telegraph Department, and a most praiseworthy and generous unanimity resulted in the raising of the magnificent sum of £350 in a very short time. The matter was also taken up in the provinces, with the result that £150 were realised with gratifying alacrity. Nothing approaching this sum has ever been subscribed before, though charity, philanthropy and generosity are by no means strangers to the Telegraph Service, but then on the other hand there has never been a case in which individual and collective responsibility has been involved to so great an extent. The presentation of this handsome sum was to have taken place in public. Notice was given to the "authorities," who gave unmistakable proof that their peculiar code of honour would be outraged by what many in a thoroughly dispassionate neutrality of mind would consider an enthusiasm of noble kindness and gratitude. Equally impartial people will wonder where the right has been acquired which permits of interference with, and practical subversion of, one of our most cherished social institutions—the right of public meeting for the purpose of presenting a testimonial, or the discharge of any other social ceremonial. Possibly the St. Martin's-le-Grand officials may have acquired such rights by methods satisfactory to themselves, but it may be doubted whether they would meet with the approval of the public at large. There being no desire, we suppose, on the part of the Telegraph Clerks to bring about a display of hostility to the Postmaster-General or the permanent officials the projected meeting was abandoned, and the Quin testimonial—which took the form of a tastefully illuminated and kindly worded address, a silver medal, specially struck, and a sum of nearly £500—was presented to the recipient privately.

Into the feelings which must have thrilled the heart of Quin, it is not necessary to enter at any length. The substantial sympathy of his former colleagues will make up something akin to ample recompense for the prospects nipped at the best in the stem only—and it must surely be felt that there were the grandest and most genuine reasons for this extraordinary display of practical and thorough friendship, and that Quin was in every way worthy of the reciprocal loyalty of his friends.

However, happy in the possession of a temperament and a heart not easily daunted, Quin has apparently lost but little time in putting the whole matter before

the eyes of the public in a way which has utterly defeated the desires of those who longed for his relegation to public and commercial obscurity.

The latest phase of the matter will strongly remind some of our readers of the tinker who, in mending one hole, made two fresh ones—in the tinker's case the result was premeditated, but the action of the authorities in the Quin affair has led to the whole thing stepping into the broad light of public opinion, for boldly displayed, in the spacious window of the friendly City photographer's premises may be seen the testimonial from the Postal Telegraph staff of the United Kingdom and the silver presentation medal, together with large and plainly worded cards announcing the circumstances which have led to their exhibition before the eyes of the public.

## RECENT RESEARCHES ON THE ELECTRICAL CONDUCTIVITY OF CERTAIN LIQUIDS.

IN our issue of the ELECTRICAL REVIEW for October 31st, we called attention to some recent researches on the electrical conductivity of certain saline solutions, giving a brief sketch of the work which is being carried on in this direction by some of the French and German scientists. Another German has now entered this interesting field of investigation. Herr F. J. Wershoven has lately been examining the electrical conductivity of aqueous solutions of the cadmium salts. We give a brief *resumé* of his more important results.

Wershoven undertook the study of solutions of the chloride, bromide, iodide, nitrate, and sulphate of cadmium, also of potassium-cadmium oxide; these were examined within wide limits of concentration and temperature.

It was found that the temperature-coefficients of all these salts of cadmium approximated very closely in extremely dilute solutions to 2·3 per cent. per degree. To this statement, however, the iodide and double iodide of cadmium are exceptions.

The variations of electrical conductivity with the variations of temperature may, in the case of concentrated solutions, be expressed by a linear equation for the chloride, iodide, and double iodide of cadmium; an equation of the second degree is, however, required, in order to express these variations in the case of the other salts of cadmium.

Grotrian's figures for electrical conductivity are well known, and have been very generally relied upon, but Wershoven fails to confirm them, and is of opinion that they must not be so implicitly trusted as they have been. He finds that there is sometimes so large a difference as 10 per cent. between his results and Grotrian's numbers, and suggests that possibly the preparations used by the latter were not in a sufficient state of purity.

Wershoven enters into a long discussion of the results with respect to molecular conductivity, the rate of transference of the ions, and the supposed complexity of the salt molecules. This is not capable of useful abstraction for our readers; we therefore merely give the conclusions arrived at.

Arrhenius held that in the case of cadmium nitrate the inactive molecules are not complex, but that in the other salts of this metal they do possess a certain degree of complexity. This view is supported by Wershoven, who finds it to agree with the results deduced from his own experiments.

Combined with the well-known values of Kohlrausch for the speed of migration of the anions (*a*), chlorine (*b*), bromium (*c*), iodine, and (*d*) the radicle $NO_3$, the numbers obtained for extreme states of dilution give the following speeds of the cadmium ion :—

For (*a*) speed = 49·2
„ (*b*) „ = 50·9
„ (*c*) „ = 49·3
„ (*d*) „ = 53·7
} Mean = 51.

The speeds of other ions expressed in the same units are for the following bivalent metals :—

| | | | | | |
|---|---|---|---|---|---|
| Barium : | speed | ... | ... | = | 51 |
| Zinc : | „ | ... | ... | = | 51 |
| Magnesium : | „ | ... | ... | = | 53 |

During the course of his investigation Wershoven found that a freshly platinised platinum electrode, when immersed in a solution of iodide of potassium, had the effect of colouring the solution at first yellow, and then in a few minutes, pink.

This interesting result is not, as might perhaps be reasonably supposed, due to the liberation of iodine, for Wershoven could not obtain the characteric blue colouration with the usual starch-paste test. He considers that it is accounted for by the formation of platinum tetriodide, which dissolves in the solution of potassium iodide. The reaction seems capable of expression by the following equation :—

$$Pt\,Cl_4 + 4\,K\,I = Pt\,I_4 + 4\,K\,Cl.$$

In order to obtain this effect it is not necessary to previously immerse the platinum electrode in a solution of platinum chloride; hydrochloric acid alone effects the reaction which indeed may be used as a most delicate test for this acid: it will even give results when the usual reagent nitrate of silver gives no turbidity whatever.

In applying this test, Wershoven recommends the following method of procedure, which we give, thinking it might be of advantage to some of our readers who may be engaged upon certain branches of delicate research.

The freshly platinised electrode is washed in distilled water and then dipped repeatedly into potassium iodide solution until it no longer produces any pink colouration. It is then thoroughly washed with aqueous alcohol, then with distilled water, after which it is placed for some time in the solution which is suspected of containing hydrochloric acid. The electrode is again subjected to careful washing with water and then immersed in a dilute solution of potassium iodide. After a little while the pink colour will appear. Neither ordinary chloride nor hydrobromic or other acid give the colouration, so the test is quite unique.

## THE ELECTRO-MAGNET.*

By Prof. SILVANUS P. THOMPSON, D.Sc., B.A., M.I.E.E.

(*Continued from page* 633.)

### SPECIFICATIONS OF ELECTRO-MAGNETS.

One frequently comes across specifications for construction which prescribe that an electro-magnet shall be wound so that its coil shall have a certain resistance. This is an absurdity. Resistance does not help to magnetise the core. A better way of prescribing the winding is to name the ampère-turns and the temperature limit of heating. Another way is to prescribe the number of watts of energy which the magnet is to take. Indeed it would be well if electricians could agree upon some sort of figure of merit by which to compare electro-magnets, which should take into account the magnetic output, *i.e.*, the product of magnetic flux into magneto-motive force—the consumption of energy in watts, the temperature rise, and the like.

### AMATEUR RULE ABOUT RESISTANCE OF ELECTRO-MAGNET AND BATTERY.

In dealing with this question of winding copper on a magnet core, I cannot desist from referring to that rule which is so often given, which I often wish might dissapear from our text books; the rule which tells you in effect that you are to waste 50 per cent. of the energy you employ. I refer to the rule which states that you will get the maximum effect out of an electro-magnet if you so wind it that the resistance is equal to the resistance of the battery you employ; or that if you have a magnet of a given resistance you ought to employ a battery of the same resistance. What is the meaning of this rule? It is a rule which is absolutely meaningless unless in the first case the volume of the coil is prescribed once for all, and you cannot alter it, or unless once for all

* Cantor Lecture. Delivered before the Society of Arts, February 3rd, 1890.

the number of battery elements that you can have is prescribed. If you have to deal with a fixed number of battery elements, and you have to get out of them the biggest effect in your external circuit, and cannot beg, buy, or borrow, any more cells, it is perfectly true that, for steady currents, you ought to group them so that their internal resistance is equal to the external resistance that they have to work through; and then, as a matter of fact, half the energy of the battery will be wasted, but the output will be a maximum. Now that is a very nice rule indeed for amateurs, because an amateur generally starts with the notion that he does not want to economise in his rate of working; it does not matter whether the battery is working away furiously, heating itself, and wasting a lot of power; all he wants is to have the biggest possible effect for a little time out of the fewest cells. It is purely an amateur's rule, therefore, about equating the resistance inside to the resistance outside. But it is absolutely fallacious to set up any such rule for serious working; and not only fallacious, but absolutely untrue if you are going to deal with currents that are going to be turned off and on quickly. For any apparatus like an electric bell, or rapid telegraph, or induction coil or any of those things where the current is going to vary up and down rapidly, it is a false rule, as we shall see presently. What is the real point of view from which one ought to start? I am often asked questions by, shall I say, amateurs as well as by those who are not amateurs, about prescribing the battery for a given electro-magnet, or prescribing an electro-magnet for a given battery. Again, I am often told of cases of failure in which a very little common sense rightly directed might have made a success. What one ought to think about in every case is not the battery, not the electro-magnet, but *the line*. If you have a line, then you must have a battery and electro-magnet to correspond. If the line is short and thick, a few feet of good copper wire, you should have a short thick battery (a few big cells, or one big cell), and a short thick coil on your electro-magnet. If you have a long thin line, miles of it, say, you want a long thin battery (small cells, and a long row of them) and a long thin coil. That is then our rule; for a short thick line, a short thick battery, and a short thick coil; for a long thin line, a long thin battery; and electro-magnet coils to match. You smile: but it is a really good rule that I am giving you; vastly better than the worn-out amateur rule.

But, after all, my rule does not settle the whole question, because there is something more than the whole resistance of the circuit to be taken into account. Whenever you come to rapidly acting apparatus, you have to think of the fact that the current, while varying, is governed not so much by the resistance as by the inertia of the circuit—its electro-magnetic inertia. As this is a matter which will claim our especial attention hereafter, I will leave battery rules for the present, and proceed with the question of design.

### Forms of Electro-Magnets.

This at once leads us to consider the classification of forms of magnets. I do not pretend to have found a complete classification. There is a very singular book written by Mons. Nicklés, in which he classifies under 37 different heads all conceivable kinds of magnets, bidromic, tridromic, monocnemic, multidromic, and I do not know how many more; but the classification is both unmeaning and unmanageable. For my present purpose I will simply pick out those which come under three or four heads, and deal separately with others that do not quite fit under any of the four categories.

*Bar Electro-magnets.*—In the first place there are those which have a straight core, of which there are several specimens on the table here.

*Horseshoe Electro-magnets.*—Then there are the horseshoes, of which some are of one piece bent, and others are of the more frequent shape made of three pieces.

*Iron-clad Electro-magnets.*—Then from the horseshoes I go to those magnets in which the return circuit of the iron comes back outside the coil either from one end or the other, or from both ends, sometimes in the form of an external tube or jacket, sometimes merely with a parallel return yoke, or two parallel return yokes. All such magnets I propose to call—following the fashion that has been adopted for dynamos—iron-clad electromagnets. One of them, the jacketted electromagnet, is shown in fig. 12 and there are others not so well known. There is one used by Mr. Cromwell Varley, in which a straight magnet is placed between a couple of iron caps, which fit over the ends, and virtually bring the poles down close together; the circular rim of one cap being the north pole, and that of the other cap being the south pole, the two rims being close together. That plan of course produces a great tendency to leak across from one rim to the other all round. The advantages, as well as the disadvantages, of the jacketted magnet I alluded to in my last lecture, when I pointed out to you that for all action at a distance it is far better not to have an iron-clad return path, whereas for action in contact the iron-clad magnet was distinctly a very good form. In one form of iron-clad magnet the end of the straight central core is fixed to the middle of a bar of iron, the ends of which are bent up and brought flush with the top of the bobbin, making thus a tripolar magnet, with one pole between the other two. The armature in this form is a bar which lies right across the three poles. There is an example of this excellent kind of electromagnet applied in one of the forms of electric bell indicator made by Messrs. Gent, of Leicester.

Then, besides these three main classes—the straight bar, the horseshoe, and the iron-clad—there is another form which is so useful, and so commonly employed in certain work, that it deserves to have a name of its own. It is that called by Count Du Moncel the *aimant bolteux*, or club-footed magnet (fig. 50). It is a horseshoe in fact, with a coil upon one pole and no coil upon the other. The advantage of that construction is simply, I suppose, that you will save labour—you will only have to wind the wire on one pole instead of two. Whether that is an improvement in any other sense is a question for experiment to determine; but on which theory perhaps might now be able to say something. Count Du Moncel, who made many experiments on this form of magnet, ascertained that there was for an equal weight of a copper a slight falling off in power with the club-footed magnet. Indeed one might almost predict, for a given weight of copper, if you wound all in one coil only, you will not make as many turns as if you wound it in two; the outer turns on the coil being so much larger than the average turn when wound in two coils. Consequently the number of ampère turns with a given weight of copper would

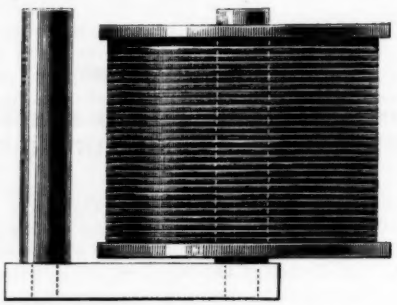


FIG. 50.—CLUB-FOOTED ELECTRO-MAGNET.

be rather smaller, and you would require more current to bring the magnetising power up to the same value as with the two coils. At the same time the one coil may be produced a little more cheaply than the two; and, indeed, such electro-magnets are really quite common, being largely used, for the sake of cheapness and compactness, in indicators of electric bells.

Du Moncel tried various experiments about this form to find whether it acted better when the armature was pivotted over one pole or over the other, and found it worked best when the armature was actually hinged on to that pole which comes up through the coil. He made two experiments, trying coils on one or other limb, the armature being in each case set at an equal distance. In one experiment he found the pull was 35 grammes, with an armature hinged on to the idle pole, and 40 grammes when it was hinged on to the pole which carried the coil.

Another form of electro-magnet, having but one coil, is used in the electric bells of church-bell pattern, of which Mr. H. Jensen is the designer. In Jensen's electro-magnet a straight cylindrical core receives the bobbin for the coil, and after this has been pushed into its place, two ovate pole-pieces are screwed upon its ends, serving thus to bring the magnetic circuit across the ends of the bobbin, and forming a magnetic gap along the side of the bobbin. The armature is a rectangular strip of soft iron, about the same length as the core, and is attracted at one end by one pole-piece, and at the other end by the other.

### Effect of Size of Coils.

Seeing that the magnetising power which a coil exerts on the magnetic circuit which it surrounds is simply proportional to the ampère turns, it follows that those turns which lie on the outside layers of the coil, though they are further away from the iron core, possess precisely equal magnetising power. This is strictly true for all closed magnetic circuits; but in those open magnetic circuits where leakage occurs it is only true for those coils which encircle the leakage lines also. For example, in a short bar electro-magnet, of the wide turns on the outer layer, those which encircle the middle part of the bar do enclose all the magnetic lines, and are just as operative as the smaller turns that underlie them; whilst those wide turns which encircle the end portions of the bar are not so efficient, as some of the magnetic lines leak back past these coils.

### Effect of Position of Coils.

Among the other researches which Du Moncel made with respect to electro-magnets, was one on the best position for placing the coil upon the iron core. This is a matter that other experimenters have examined. In Dub's book, "Electro-magnetismus," to which I have several times referred, you will also find many experiments on the best position of a coil; but it is perhaps sufficient to narrate a single example. Du Moncel had four pairs of bobbins made of exactly the same length, and with 50 metres of wires on each, one pair was 16 centimetres long, another pair 8 centimetres, or half the length, with not quite so many turns, because of course the diameter of the outer turns was larger, one 4 centimetres in length and another 2 centimetres. These were tried both with bar magnets and horseshoes. It will suffice perhaps to give the result of the horeshoe. The horseshoe was made long enough—16 centimetres only, a little over 6 inches long—to carry the longest coil. Now when the compact coils 2 centimetres long were used, the pull on the armature at a distance away of 2 millimetres (it was always the same, of course, in the experiments) was 40 grammes. Using the same

weight of wire, but distributed on the coils twice as long, the pull was 55 grammes. Using the coils 8 centimetres long, it was 75 grammes; and using the coils 16 centimetres long, covering the length of each limb, the pull was 85, clearly showing that, where you have a given length of iron, the best way of winding a magnet to make it pull with its greatest pull, is not to heap the coil up against the poles, but to wind it uniformly, for this mode of winding will give you more turns, therefore more ampère turns, therefore more magnetisation. An exception might, however, occur in some case where there is a large percentage of leakage. With club-footed magnets results of the same kind are obtained. It was found in every case that it was well to distribute the coil as much as possible along the length of the limb. All these experiments were made with a steady current. It does not follow, however, because winding the wire over the whole length of core is best for steady currents that it is the best winding in the case of a rapidly varying current; indeed, we shall see that it is not.

### Effect of Shape of Section.

So far as the carrying capacity for magnetic lines is concerned, one shape of section of cores is as good as another; square or rectangular is as good as round if containing equal sectional area. But there are two other reasons, both of which tell in favour of round cores. First, the leakage of magnetic lines, from core to core is, for equal mean distances apart, proportional to the surface of the core; and the round core has less surface than square or rectangular of equal section. All edges and corners, moreover, promote leakage. Secondly, the quantity of copper wire that is required for each turn will be less for round cores than for cores any other shape, for of all geometrical figures of equal area the circle is the one of the least periphery.

### Effect of Distance between Poles.

Another matter that Du Moncel experimented upon, and Dub and Nicklès likewise, was the distance between the poles. Dub considered that it made no difference how far the poles were apart. Nicklès had a special arrangement made which permitted him to move the two upright cores or limbs, 9 centimetres high, to and fro on a solid bench or yoke of iron. His armature was 30 centimetres long. Using very weak currents he found the effect best when the shortest distance between the poles was 3 centimetres; with a stronger current 12 centimetres; and with his strongest current nearly 30 centimetres. I think leakage must have a deal to do with these results. Du Moncel tried various experiments to elucidate this matter, and so did Prof. Hughes, in an important, but too little-known, research which came out in the *Annales Télégraphiques*, in the year 1862.

### Researches of Professor Hughes.

His object was to find out the best form of electro-magnet, the best distance between the poles, and the best form of armature for the rapid work required in Hughes's printing telegraphs. One word about Hughes's magnets. This diagram (fig. 51) shows the

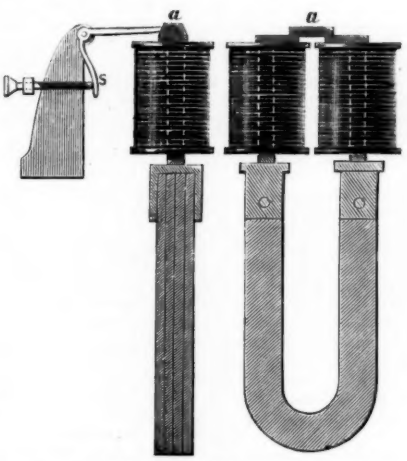



Fig. 51.—Hughes's Electro-magnet.

form of the welf-known Hughes's electro-magnet. I feel almost ashamed to say these words "well-known," because although on the continent everybody knows what you mean by a Hughes's electro-magnet, in England scarcely anyone knows what you mean. Englishmen do not even know that Prof. Hughes has invented a special form of electro-magnet. Hughes's special form is this:—A permanent steel magnet, generally a compound one, having soft iron pole pieces, and a couple of coils on the pole pieces only. As I have to speak of Hughes's special contrivance amongst the mechanisms that will occupy our attention next week, I only now refer to this magnet in one particular. If you wish a magnet to work rapidly, you will secure the most rapid action not when the coils are distributed all along but when they are heaped up near, not necessarily entirely on, the poles. Hughes made a number of researches to find out what the right length and thickness of these pole pieces should be. It was found an advantage not to use too thin pole pieces, otherwise the magnetism from the permanent magnet did not pass through the iron without considerable reluctance, being choked by insufficiency of section; also not to use too thick pieces, otherwise they presented too much surface for leakage across from one to the other. Eventually a particular length was settled upon, in proportion about six times the diameter, or rather longer. In the further researches that Hughes made he used a magnet of shorter form, not shown here, more like those employed in relays, and with an armature from 2 to 3 millimetres thick, 1 centimetre wide, and 5 centimetres long. The poles were turned over at the top towards one another. Hughes tried whether there was any advantage in making those poles approach one another, and whether there was any advantage in having as long an armature as 5 centimetres. He tried all different kinds, and plotted out the results of observations in curves, which could be compared and studied. His object was to ascertain the conditions which would give the strongest pull, not with a steady current but with such currents as were required for operating his printing telegraph instruments; currents which lasted but one to twenty hundredths of a second. He found it was decidedly an advantage to shorten the length of the armature, so that it did not protrude far over the poles. In fact he got a sufficient magnetic circuit to secure all the attractive power that he needed, without allowing as much chance of leakage as there would have been had the armature extended a longer distance over the poles. He also tried various forms of armature having various cross sections.

### Position and Form of Armature.

In one of Du Moncel's papers on electromagnets* you will also find a discussion on armatures, and the best forms for working in different positions. Amongst other things in Du Moncel you will find this paradox; that whereas using a horseshoe magnet with flat poles, and a flat piece of soft iron for armature, it sticks on far tighter when put on edgways; on the other hand, if you are going to work at a distance, across air, the attraction is far greater when it is set flatways. I explained the advantage of narrowing the surfaces of contact by the law of traction, $B^2$ coming in. Why should we have for an action at a distance the greater advantage from placing the armature flatway to the poles? It is simply that you thereby reduce the reluctance offered by the air gap, to the flow of the magnetic lines. Du Moncel also tried the difference between round armatures and flat ones, and found that a cylindrical armature was only attracted about half as strongly as a prismatic armature, having the same surface when at the same distance. Let us examine this fact in the light of the magnetic circuit. The poles are flat. You have at a certain distance away a round armature; there is a certain distance between its nearest side and the polar surfaces. If you have at the same distance away a flat armature having the same surface, and, therefore, about the same tendency to leak, why do you get a greater pull in this case than in that? I think it is clear that if they are at the same distance away, giving the same range of motion, there is a greater magnetic reluctance in the case of the round armature, although there is the same periphery, because though the nearest part of the surface is at the prescribed distance, the rest of the under surface is farther away; so that the gain found in substituting an armature with a flat surface is a gain resulting from the diminution in the resistance offered by the air gap.

### Pole Pieces on Horseshoe Magnets.

Another of Du Moncel's researches† relates to the effect of polar projections or shoes—moveable pole pieces, if you like—upon a horseshoe electro-magnet. The core of this magnet was of round iron 4 centimetres in diameter, and the parallel limbs were 10 centimetres long and 6 centimetres apart. The shoes consisted of two flat pieces of iron slotted out at one end, so that they could be slid along over the poles and brought nearer together. The attraction exerted on a flat armature across air gaps 2 millimetres thick, was measured by counterpoising. Exciting this electro-magnet with a certain battery, it was found that the attraction was greatest when the shoes were pushed to about 15 millimetres, or about one quarter of the inter-polar distance apart. The numbers were as follows:—

| Distance between shoes. Millimetres. | Attraction in grammes. |
|---|---|
| 2 | 900 |
| 10 | 1,012 |
| 15 | 1,025 |
| 25 | 965 |
| 40 | 890 |
| 60 | 550 |

With a stronger battery the magnet without shoes had an attraction of 885 grammes, but with the shoes 15 millimetres apart, 1,195 grammes. When one pole only was employed, the attraction, which was 88 grammes without a shoe, was *diminished* by adding a shoe to 39 grammes!

### Contrast between Electro-Magnets and Permanent Magnets.

Now I want particularly to ask you to guard against the idea that all these results obtained from electro-magnets are equally applicable to permanent magnets of steel; they are not, for this simple reason. With an electro-magnet, when you put the armature near, and make the magnetic circuit better, you not only get

* *La Lumière Electrique*, vol. ii.
† *La Lumière Electrique*, vol. iv., p. 129.

more magnetic lines going through that armature, but you get more magnetic lines going through the whole of the iron. You get more magnetic lines round the bend when you put an armature on to the poles, because you have a magnetic circuit of less reluctance, with the same external magnetising power in the coils acting around it. Therefore, in that case, you will have a greater magnetic flux all the way round. The data obtained with the electro-magnet (fig. 42), with the exploring coil, C, on the bend of the core, when the armature was in contact, and when it was removed, are most significant. When the armature was present it multiplied the total magnet flow tenfold for weak currents, and nearly threefold for strong currents. But with a steel horseshoe, magnetised once for all, the magnetic lines that flow around the bend of the steel are a fixed quantity, and however much you dimish the reluctance of the magnetic circuit you do not create or evoke any more. When the armature is away the magnetic lines arch across, not at the ends of the horseshoe only, but from its flanks; the whole of the magnetic lines leaking somehow across the space. When you have put the armature on, these lines, instead of arching out into space as freely as they did, pass for the most part along the steel limbs and through the iron armature. You may still have a considerable amount of leakage, but you have not made one line more go through the bent part. You have absolutely the same number going through the bend with the armature off as with the armature on. You do not add to the total number by reducing the magnetic reluctance, because you are not working under the influence of a constantly impressed magnetising force. By putting the armature on to a steel horseshoe magnet you only *collect* the magnetic lines, you do not *multiply* them. This is not a matter of conjecture. A group of my students have been making experiments in the following way. They took this large steel horseshoe magnet (fig. 52) the

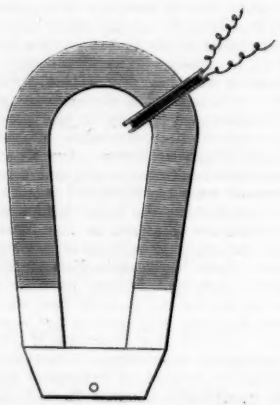


FIG. 52.—EXPERIMENT WITH PERMANENT MAGNET.

length of which from end to end through the steel is 42¼ inches. A light narrow frame was constructed so that it could be slipped on over the magnet, and on it were wound 30 turns of fine wire, to serve as an exploring coil. The ends of this coil were carried to a distant part of the laboratory, and connected to a sensitive ballistic galvanometer. The mode of experimenting is as follows:—The coil is slipped on over the magnet (or over its armature) to any desired position. The armature of the magnet is placed gently upon the poles, and time enough is allowed to elapse for the galvanometer needle to settle to zero. The armature is then suddenly detached. The first swing measures the change, due to removing the armature, in the number of magnetic lines that pass through the coil in the particular position.

I will roughly repeat the experiment before you: the spot of light on the screen is reflected from my galvanometer at the far end of the table. I place the exploring coil just over the pole, and slide on the armature; then close the galvanometer circuit. Now I detach the armature, and you observe the large swing. I shift the exploring coil, right up to the bend; replace the armature; wait until the spot of light is brought to rest at the zero of the scale. Now, on detaching the armature, the movement of the spot of light is quite imperceptible. In our careful laboratory experiments, the effect was noticed inch by inch all along the magnet. The effect when the exploring coil was over the bend was not as great as $\frac{1}{1000}$th part of the effect when the coil was hard up to the pole. We are therefore justified in saying that the number of magnetic lines in a permanently magnetised steel horseshoe magnet is not altered by the presence or absence of the armature.

You will have noticed that I always put on the armature gently. It does not do to slam on the armature: every time you do so, you knock some of the so called permanent magnetism out of it. But you may pull off the armature as suddenly as you like. It does the magnet good rather than harm. There is a popular superstition that you ought never to pull off the keeper of a magnet suddenly. On investigation, it is found that the facts are just the other way. You may pull off the keeper as suddenly as you like; but you should never slam it on.

From these experimental results I pass to the special design of electro-magnets for special purposes.

*(To be continued.)*

# PROCEEDINGS OF SOCIETIES.

## The Institution of Electrical Engineers.

*Read Thursday, November 13th.*

"Notes on the Chemistry of Secondary Cells." By Prof. W. E. AYRTON, Vice-President; C. G. LAMB, B.Sc., and E. W. SMITH, Associates.

I.

IN our paper on "The Working Efficiency of Secondary Cells," read at the meeting of this Institution in Edinburgh in July, it was stated that, "In spite of accumulators with pasted plates having been in use now for nine years, the chemical action that takes place during the different stages of the charge and discharge has only been conjectured, and, odd as it seems, no decisive experiment appears to have been made to settle this much-debated question. Various analyses have been made by different chemists of salts of lead acted on in certain ways with sulphuric acid, but apparently not of actual accumulator plates in action. We are therefore now, with the assistance of Mr. Robertson, making a complete investigation of the chemical state of the plugs of both the positive and negative plates at all stages of the charge and discharge of an 1888 E.P.S. type of accumulator in good condition." The present paper contains an account of the results thus obtained.

The cell selected to remove the plugs from had the same size as the cells employed in the investigations described in the previous communication, and was one of the batch of 50 purchased for the Central Institution about the middle of 1888. Since it first came into our possession it had never been overcharged, never been left discharged, nor permitted to send more than the maximum current allowed by the makers for cells of this size—viz., 10 ampères—and consequently, at the beginning of the present investigation in June of this year, this cell was in excellent condition.

First the cell was several times charged with a current of 9 ampères, and discharged with a current of 10, without stopping day or night, so as to bring it into what we have called its steady "working" state. The dotted curves, figs. 1 and 2, show the large charge and discharge obtained on June 28th. During the next charge, indicated by the continuous curve, fig. 1, plugs were removed from both the positive and negative plates at the points marked A, B, C, and D, when the terminal P.D. of the cell was 2·134, 2·2, 2·234, and 2·4 volts respectively. In order to remove the plugs from the positive plates, these plates were bodily removed out of the liquid, but, to prevent oxidation, the negative plates were left in the liquid, and the plugs removed in a way that will be described later on. The time occupied in removing the plugs from the two sets of plates occupied about 15 to 20 minutes on each occasion. Immediately after the removal of the plugs the positive plates were put back in position in the cell, the resistance in the circuit rapidly adjusted, if necessary, to make the charging current exactly 9 ampères, and the time variation of the P.D. at the terminals of the cell noted. The interval that elapsed while the current was broken is not shown on the curve; that is to say, the P.D. observed immediately after replacing the positive plates in the liquid and closing the circuit is plotted directly under the P.D. that was observed just before the circuit was broken, prior to the removal of the positive plates from the liquid.

We were afraid that the bodily withdrawal of the positive plates out of the liquid, combined with the removal of the plugs, on the several occasions, would produce so great a change in the conditions of the cell as to render the P.D. curve quite discontinuous. It was, therefore, as interesting as it was unexpected, to find that the terminal P.D., on restarting the normal charging current of 9 ampères, rapidly acquired the value it had before the withdrawal of the plates; so that, with the exception of the rapid rise of the P.D. on restarting the charging current, the P.D. curve obtained on June 29th was almost the same as the P.D. curve obtained on charging on the previous day.

After the cell had been charged until the terminal P.D. reached 2·4 volts, it was immediately discharged with a perfectly constant current of 10 ampères, and, as it was anticipated that the removal of the plugs would spoil the cell, it was allowed to discharge far below the normal limit. In previous discharges (the last one of which is shown by the dotted line, fig. 2), the discharge was stopped when the terminal P.D. fell to 1·85 volts. But in the discharge on June 30th, when the plugs were removed, the discharge current was kept at 10 ampères, by using auxiliary cells, until the E.M.F. of the test cell fell to nought, and even reversed. Plugs were removed from both the positive and the negative plates when the terminal P.D. was 2, 1·95, 1·85, 0·6, and nought volts, as indicated by the points A′, B′, C′, D′, and E′. The recovery of the E.M.F. on breaking the circuit was very marked, especially near the end of the discharge.

II.

METHOD OF OBTAINING SAMPLES OF THE PLUGS.

On the first removal of plugs corresponding with the point A, fig. 1, a curved pointed glass rod was used, as shown in fig. 3, with the idea of prising out the plugs; but by this method only the surface of the positive plugs could be removed, as they were much too hard to be loosened in this way. Indeed, one of the most striking things noticed in this investigation was the firm

way in which the plugs were held in the plates of an E.P.S. cell that had been carefully used for two years. Before the next attempt was made to remove plugs corresponding with the point B, fig. 1, a straight piece of glass rod was pointed, and mounted in a wooden handle. This glass chisel was used to pierce and loosen the positive plugs, which were then driven bodily out of the grid by means of a hard wooden punch cut square to fit the holes in the grid, and which was tapped with a small mallet. The plugs on being driven out of the grid were caught in a long wooden scoop (shaped so that it could be just slipped in between the plates), and then washed by Mr. Robertson into wide-mouthed bottles containing three or four hundred c.c. of distilled water. As soon as the water cleared it was decanted off and fresh added.

handle, as shown in fig. 4. It was possible to use this method throughout for the removal of the negative plugs, as they were softer and more easily removable than the positive ones. The scoop held sufficient liqnid to enable the negative plugs to be dropped into wide-necked bottles containing water without the plugs being even momentarily exposed to the air. The water in these bottles Mr. Robertson had washed free from dissolved oxygen by previously bubbling hydrogen through it for a considerable time. After the negative plugs had been put into the botttes the water was gradually decanted off from time to time, and fresh added until the liquid in the bottle was quite free from acid.

Both in the case of the positives and the negatives the top

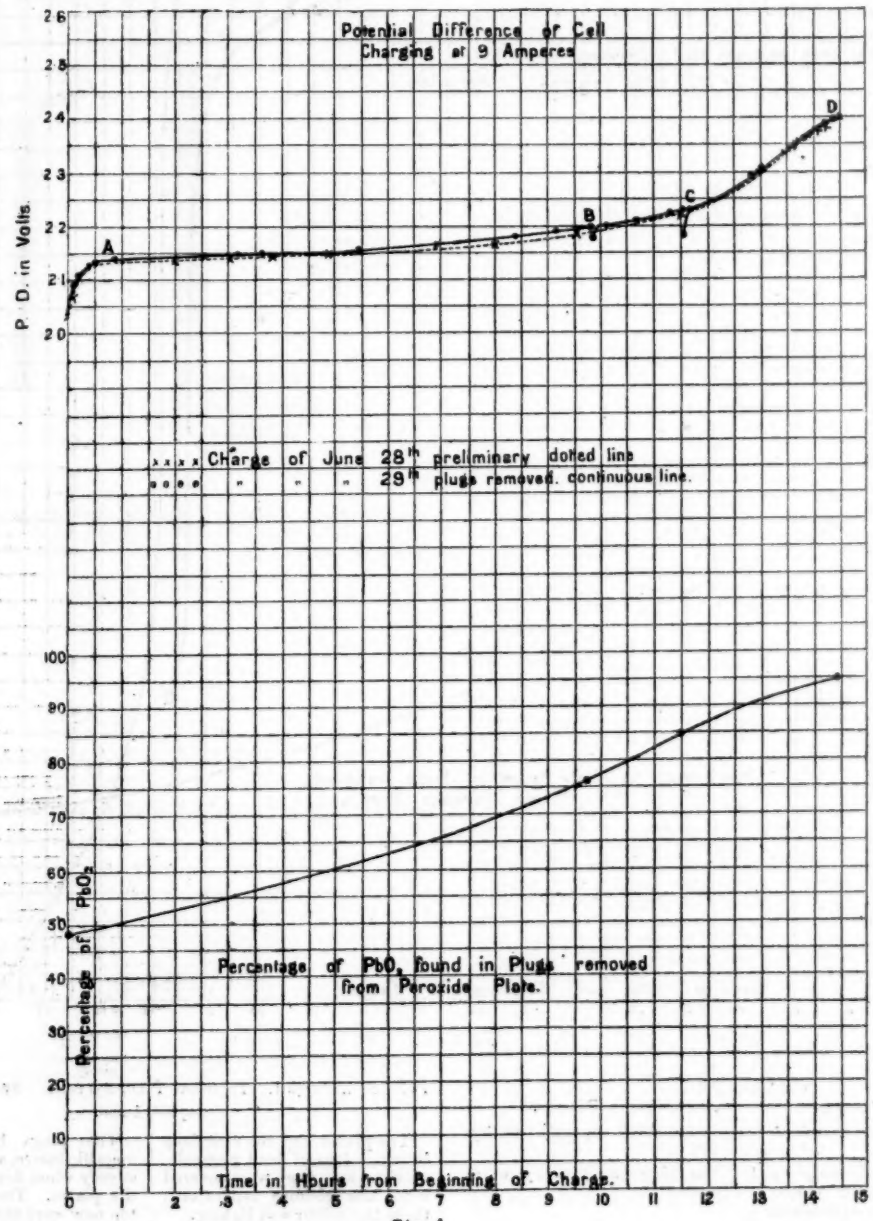

Potential Difference of Cell
Charging at 9 Amperes
P. D. in Volts.
A
B
C
D
Charge of June 28th preliminary dotted line
" " 29th plugs removed. continuous line.
Percentage of PbO2
Percentage of PbO2 found in Plugs removed from Peroxide Plate.
Time in Hours from Beginning of Charge.

Fig. 1.

As several glass chisels were broken, and the wooden punches worn down in the removal of the plugs, the method has the disadvantage of mixing with the specimens to be analysed splinters of glass and wood, which were found difficult to remove afterwards. On the other hand, the method had the advantage of enabling specimens of the positive plugs to be removed in a comparatively short time on each occasion from the top, the middle, and the bottom of the plates.

As the negative plates were never removed from the acid, the only way to remove the plugs was by working them loose under the liquid by means of long curved glass rods pointed at the end, and by catching the plugs in a narrow wooden scoop with a long

samples were removed from the corner of the plates nearest the lug, and the bottom samples from the corner diametrically opposite, so as to obtain evidence, if possible, of any difference of current density which might exist at different parts of the plates in charging and discharging.

The plugs from the top, the middle, and the bottom of each set of plates were at each of the removals of plugs put into six separate bottles, and, to avoid the possibility of error in their subsequent identification, there was noted on the label of each the character of the plates and the position on them from which the plugs were removed, the time, the P.D., and the specific gravity of the liquid in the cell.

III.

APPEARANCE OF PLATES AT REMOVALS OF PLUGS.

The following notes were made by Mr. Robertson and ourselves at the succcsaive removals of the plugs :—

*Point* C *on Curve* 1. *Terminal* P.D., 2·234 *volts. Specific Gravity of Liquid,* 1·201.

The previous charges increased in amount.

The previous charges increased in amount.

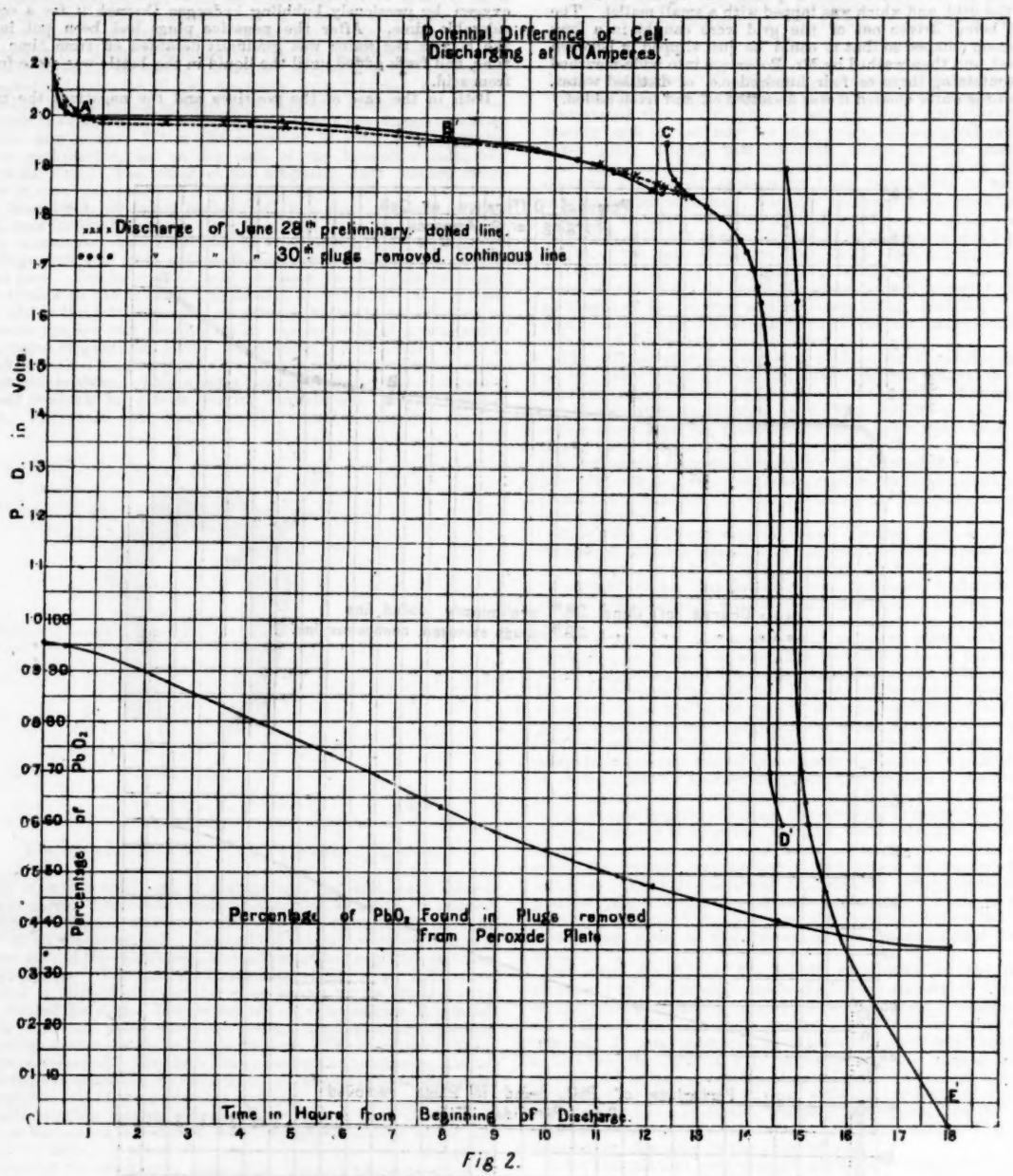

Potential Difference of Cell Discharging at 10 Amperes.
A'
B'
C'
D'
E'
Discharge of June 28th preliminary. dotted line.
" " 30th plugs removed. continuous line
P.D. in Volts.
Percentage of $PbO_2$
Percentage of $PbO_2$ Found in Plugs removed from Peroxide Plate
Time in Hours from Beginning of Discharge.

*Fig 2.*

## CHARGING.

POSITIVE PLATES. NEGATIVE PLATES.

*Point* A *on Curve* 1. *Terminal* P.D., 2·134 *volts. Specific Gravity of Liquid,* 1·178.

The upper part of the plates had a greyish-brown colour, and presented the appearance of being coated with a very thin film of white sulphate. The lower part of the plates was of a reddish-brown colour.

The plugs at the top were hard, while those at the bottom were quite soft.

The plugs at the top were the softest.

*Point* B *on Curve* 1. *Terminal* P.D., 2·2 *volts. Specific Gravity of Liquid,* 1·198.

The plates had entirely lost their whitish appearance, and showed a uniform reddish-brown colour, darker than the previous colour of the bottom of the plates.

The plugs both at the top and at the bottom harder than before, those at the top having hardened more than those at the bottom.

*Point* D *on Curve* 1. *Terminal* P.D., 2·4 *volts. Specific Gravity of Liquid,* 1·206.

The plates had the rich deep brown colour of lead peroxide, except where they were covered with the ebonite separators: there the colour was lighter.

The plugs at the top were slightly the softest, while those at the bottom were much the same as at the beginning.

The plugs had a brilliant metallic lustre, and looked quite silvery when first removed from the plates. The plugs at the top now were the hardest.

## DISCHARGING.

POSITIVE PLATES. NEGATIVE PLATES.

*Point* A' *on Curve* 2. *Terminal* P.D., 1·993 *volts. Specific Gravity of Liquid,* 1·205.

The plugs at the top were harder than those at the bottom.

The plugs had the brilliant metallic lustre observed at the end of the charging.

*Point c' on Curve 2. Terminal* P.D., 1·850 *volts. Specific Gravity of Liquid,* 1·180.

| | |
|---|---|
| The plugs had become much harder. | The plates had become decidedly white, and the plugs were white right through. |

*Point* D' *on Curve 2. Terminal* P.D., 0·6 *volt. Specific Gravity of Liquid,* 1·175.

| | |
|---|---|
| The plugs had become extremely hard, especially at the bottom. | The plugs were somewhat softer. |

*Point* E' *on Curve 2. Terminal* P.D., 0 *volt. Specific Gravity of Liquid,* 1·172.

| |
|---|
| The plugs had become so hard that they splintered and bits flew about on trying to remove them. |

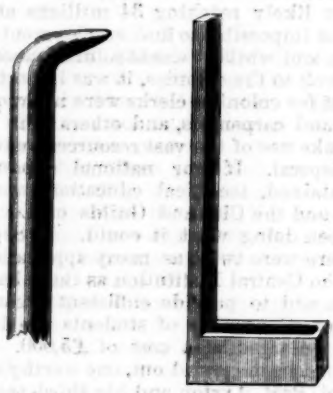


FIG. 3.



FIG. 4.

The bubbling of gas from the negative plates ceased when the terminal P.D. on discharging fell to 1·85 volts (point c' on curve 2), and it began again when the terminal P.D. fell to somewhere near zero.

FIG. 5.—*Charging*

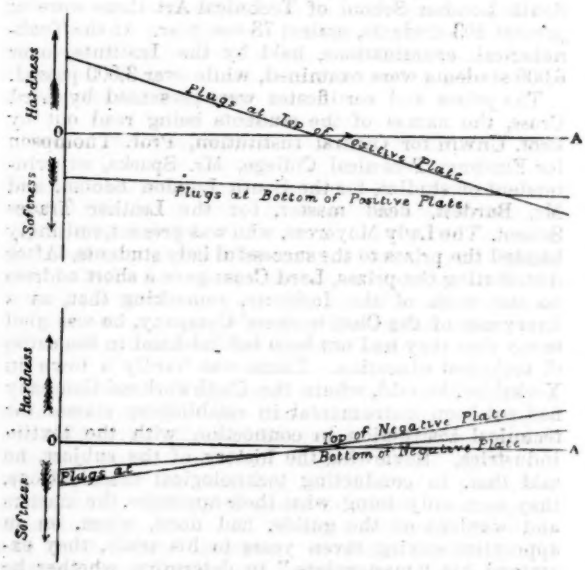



FIG. 6.

The following figures (5 and 6) give an idea of the way in which we found the hardness of the top and bottom plugs of the positive and the negative plates respectively to vary during a normal charge. The figures are not drawn to scale, as we had no standard of hardness beyond our sensations, hence the figures only profess to be qualitative sketches from which mental pictures can be obtained. Distance measured upways from O A indicates roughly the degree of hardness; distance measured downwards the degree of softness.

It will be seen that during the charging the variation in the hardness of the plugs is far greater at the top than at the bottom of the plates, and consistently with this fact Mr. Robertson's analyses show that, on the whole, the rate of chemical action at the top of the plates is greater than at the bottom. The difference in the hardness, however, is far more marked than the difference in the chemical action. For example, while the plugs at the top of the positive plates are, during the earlier part of the charging, much harder than those at the bottom, no such striking difference is observable in the percentage of lead peroxide contained by these plugs. The cause of this we are examining experimentally at the present time.

In order to see how far the resistance of the lead grid would tend to make the current density in the upper part of the liquid less than in the lower, as well as for the purpose of seeing how large a fraction of the whole resistance of the accumulators was due to the lead lugs and to the connections between the successive pairs of lugs, the following tests were made by three of the students—Messrs. Hobson, Lee, and Montealegre:—

Parts of the lead lugs of some of the accumulators were scraped, and on these clean spots binding screws, which had been themselves filed bright, were tightly screwed. The accumulators were allowed to send measured currents, the values of which are given in the following tables, and the P.D. between the pairs of binding screws was carefully measured with a sensitive reflecting voltmeter. The resistance of the lugs between the pairs of binding screws is then at once obtained by dividing the P.D. by the current.

*(To be continued.)*

## The Royal Society.

"Magnetism and Recalescence." By J. HOPKINSON, D.Sc., F.R.S.

IN my experiments, the results of which are published, "Phil. Trans," 1889, A, p. 443, I showed that recalescence and the disappearance of magnetisability in iron and steel occurred at about the same temperature. The evidence I then gave was sufficiently satisfactory, but did not amount to absolute proof of the identity of the temperatures. Osmond has shown that the temperature of recalescence depends upon the temperature to which the iron has been heated, also that it differs when the iron is heated and when it is cooled. He also showed that for some sorts of steel the heat is liberated at more than one temperature, notably that in steel with 0·29 per cent. of carbon, heat is liberated when cooling at 720° C. and at 660° C., and that with steel with 0·82 per cent. carbon there is a considerable liberation of heat before the temperature is reached when this becomes a maximum. It appeared to be desirable to obtain absolute proof that the change of magnetic property occurred exactly when heat was liberated and absorbed, and to examine, magnetically, Osmond's two temperatures of heat liberation. I have not been able to obtain samples of steel of the size I used, showing two well marked temperatures of heat liberation and absorption, but I have a ring in which there is liberation of heat extending over a considerable range of temperature.

The samples had the form of rings. A copper wire was well insulated with asbestos, and laid in a groove running round the ring, and was covered with several layers of asbestos paper laid in the groove. This coil was used for measuring temperature by its resistance. The whole ring was served over with asbestos paper and with sheets of mica. The secondary exploring coil was then wound on, next a serving of asbestos paper and mica, and then the primary coil, and, lastly, a good serving of asbestos paper was laid over all. In this way good insulation of the secondary coil was secured, and a reasonable certainty that the temperature coil took the precise temperature of the ring, and that at any time the ring was throughout at one and the same temperature. The whole was placed in an iron pot, and this again in a Fletcher gas furnace. Observations were made of temperature as the furnace was heating, and from time to time of induction. In each case the time of observation was noted. Similar observations were made as the ring cooled, the furnace being simply extinguished. We are thus enabled to compare directly at the same instant the condition of the same ring as regards magnetism and as regards temperature, and, therefore, qualitatively as regards its absorption or liberation of heat.

The results for a ring containing 0·3 per cent. of carbon or thereabouts show that there is a considerable liberation of heat, beginning at 2 h. 12 m., temperature 715° C., and continuing to time 2 h. 22 m., temperature 660° C., being apparently somewhat slower at the end. This may, however, be only apparently slower as the furnace temperature would fall lower in relation to the ring. At time 2 h. 22 m., temperature 660° C., the rate of liberation becomes much more rapid, so much so that the temperature for a time remains almost stationary. At time 2 h. 29 m. the liberation of heat appears to have ceased, and the normal cooling to continue. Now, comparing the kicks of the galvanometer, which are proportional to the induction, it is observed that the ring begins to be magnetisable at time 2 h. 12 min., its magnetic property increases till time 2 h. 22 m.; after this point the magnetisability increases much more rapidly, and is practically fully developed at 2 h. 31 m. In this case the development of magnetic property follows precisely the whole of the liberation of heat, observed both at the temperature of about 700° C. and at 660° C. We may, therefore, be certain, that both at the higher and lower temperatures of recalescence there is magnetic change, and that the one is as much dependent on the other as the solid condition of ice is upon the liberation of heat when water solidifies. The two changes occur, not only at the same temperature, but simultaneously. A considerable magnetising force, 6·56, was taken, as it was expected and found that the magnetic property would

then be more apparent when it was in the intermediate condition between the two temperatures of recalescence.

The results of a ring containing 0·9 per cent. of carbon show that there is a slight absorption of heat at time 11 h. 17 m., temperature 710° C., with doubtful effect on the magnetism. At time 11 h. 27 m., temperature 770° C., powerful absorption of heat begins and continues to time 11 h. 55 m., temperature 808° C.; it is between these times that the magnetisability is decreasing, and at the latter time that it finally disappears. The heating was continued to about 840° C., and the flame was then put out. In cooling, heat is liberated at one point only, and in this case with a distinct rise of temperature. The recalescence begins at time 3 h. 47 m., temperature 750° C., and it is precisely at this time that the ring begins to be magnetisable. The recalescence continues to time 4 h. 8 m., and at this time, and not before it, the magnetisability practically attains a maximum. Before the last portion of the curve the ring was heated to 966° C. Here no observations were made magnetically. This part of the curve, therefore, only shows the effect of higher heating in lowering the temperature of recalescence. Unfortunately I had forgotten to record the magnetising force; it was, however, much less than in the last case, probably less than unity.

These experiments show that the liberation and absorption of heat, known as recalescence, and the change in magnetic condition, occur simultaneously. Also that in the case of steel with 0·3 per cent. of carbon both temperatures of liberation of heat are associated with change of magnetic condition.

## Physical Society.—November 14th, 1890.

Prof. W. E. AYRTON, F.R.S., President, in the chair.

The following communication was made:—

"Tables of Spherical Harmonics, with examples of their Practical Use." By Prof. J. PERRY, F.R.S. The author defined a spherical harmonic as a homogeneous function of $x$, $y$, $z$, satisfying the equation $\frac{d^2 v}{d x^2} + \frac{d^2 v}{d y^2} + \frac{d^2 v}{d z^2} = 0$, stated the fundamental properties of such functions, and pointed out their importance in problems on heat, electricity and hydro-dynamics. Referring to zonal harmonics (homogeneous functions of $(x^2 + y^2)^{\frac{1}{2}}$ and $z$), he showed that these harmonics are symmetrical with respect to the axis of $z$, and might be expressed as functions of the angle ($\theta$) which the line joining the point $(x, y, z)$ to the origin makes with the axis of $z$, multiplied by $r^i$; where $r$ is the radius vector and $i$ the degree of the homogeneous function. These functions of $\theta$ are called zonal surface harmonics, and are designated by $P_0$, $P_1$, $P_2$, &c., $P_i$ according to the degree of the function, and it was the values of these quantities which form the tables brought before the society. The tables comprise the values of $P_1$ to $P_8$, and are calculated to four places of decimals and for every 1° between 0° and 90°.

As an example of such tables, the case of a spherical surface covered with attracting matter whose density varied as the square of its distance from a diametral plane, was taken. It was required to find the potential both outside and inside the sphere, and to determine the equipotential surfaces and lines of force. The potentials inside (A) and outside (B) were shown to be given by

$$\frac{A}{\pi} = 8 + \frac{16}{5} r^2 P_2 \text{ and } \frac{B}{\pi} = \frac{8}{r} + \frac{16}{5}\frac{1}{r^3} P_2 \text{ respectively.}$$

By giving A and B definite values and choosing values of $r$, the corresponding $P_2$ can be calculated and the value of $\theta$ determined from the tables. Hence any equipotential surface can be easily determined and lines drawn to cut these surfaces orthoganally are the lines of force.

Another problem which had been tried consisted in finding the directions of the lines of force near a circular coil of rectangular cross-section when an electric current circulates in the coil. This was treated approximately by first calculating the potential at 6 points along the axis in the neighbourhood of the coil and then finding by Gauss' method the coefficients, $A_0$, $A_1$, $A_2$, &c., of an expression in ascending powers of $z$, which agreed with the calculated potentials at the points chosen. The formula

$$V = A + A_1 r P_1 + A_2 r^2 P_2 + , \&c.,$$

or its corresponding expression in inverse powers of $r$ was then assumed to give the potential at any point in the space considered. By giving V definite values, a series of equipotential surfaces were determined and the lines of force drawn. On putting the calculations to the test of experiment, the approximate solution of this very difficult problem was found to be very nearly correct.

**The John Pender Gold Medal.**—The Electrical Engineering Gold Medal, presented annually by Sir John Pender, K.C.M.G., through Prof. Jamieson, to the Glasgow and West of Scotland Technical College, has been gained by Arthur H. Allen, who, besides taking the first place in all his college classes, took the first place in the kingdom with first class honours at the Science of Arts Public Examinations, and first class honours at the City and Guilds of London Institute Technological Examinations.

## CITY AND GUILDS OF LONDON INSTITUTE.

THE annual distribution of prizes and certificates gained by students attending the various colleges of the Institute, took place at Clothworkers' Hall last Wednesday evening. The Right Hon. the Lord Mayor presided, and, in the course of his opening remarks, said it was both his duty and privilege to take part in so important a work as encouraging the spread of technical education. The question had become of vital importance, and it was only too evident that in the past elementary education had been of too academical a character; book-learning had been sought after, while the more important training of hand and eye had been greatly neglected. With the population increasing rapidly, very likely reaching 34 millions at the next census, it was impossible to find employment for all in this country, and while it was absolutely necessary that we should look to the colonies, it was important to remember that for colonists clerks were not required, but bricklayers and carpenters, and others who could use tools and make use of the vast resources nature placed at their disposal. If our national supremacy was to be maintained, technical education was essential to that end, and the City and Guilds of London Institute had been doing what it could. In September of last year there were twice as many applications for admission to the Central Institution as there had been the year before, and to provide sufficient accommodation for the increased number of students the laboratories were being enlarged at a cost of £5,000. Important researches had been carried out, one worthy of mention being that of Prof. Ayrton and his third-year students, on the "Efficiency of Secondary Cells." At Finsbury College the number which had passed the entrance examination was in excess of the number which the college could accommodate, and extensions had been rendered necessary. As a preliminary and temporary measure, a warehouse had been rented, into which the mechanical department would have to move. At the South London School of Technical Art there were at present 103 students, against 78 last year. At the Technological examinations, held by the Institute, over 6,000 students were examined, while over 3,000 passed.

The prizes and certificates were presented by Lord Cross, the names of the students being read out by Prof. Unwin for Central Institution, Prof. Thompson for Finsbury Technical College, Mr. Sparks, superintendent of studies, for the South London School, and Mr. Burdett, head master, for the Leather Trades School. The Lady Mayoress, who was present, smilingly handed the prizes to the successful lady students. After distributing the prizes, Lord Cross gave a short address on the work of the Institute, remarking that, as a liveryman of the Clothworkers' Company, he was glad to say that they had not been behind-hand in the cause of technical education. There was hardly a town in Yorkshire, he said, where the Clothworkers' Company had not been instrumental in establishing classes for technical instruction in connection with the textile industries. Reviewing the history of the subject, he said that, in conducting technological examinations, they were only doing what their ancestors, the masters and wardens of the guilds, had done, when, on an apprentice serving seven years to his trade, they examined his "masterpiece," to determine whether he might be admitted as a master craftsman. Though, with the age, the character of the examination had changed, in extent and object it was still the same. It was a mistake to suppose that they wanted to substitute the technical school for the workshop, for in the nature of things that was impossible, but he held that a workman who had a scientific reason for everything he did was a better workman than one who hadn't, and this reason the technical school endeavoured to supply.

After the usual votes of thanks had been proposed and responded to, the audience adjourned to the refreshment rooms to find further evidence of the liberality of the Clothworkers' Company.

## NOTES.

**Electric Light in Whitechapel.**—The electric light is penetrating into the East End. The Laing, Wharton and Down Construction Syndicate having applied to the Whitechapel Board for the granting of a provisional order, this body referred the matter to a committee, who reported in favour of the board taking the electric lighting of the district into its own hands. The clerk made a statement, from which it appeared that by improvements shortly to be made in a destructor they have erected, there would be waste heat sufficient to generate 100 horse-power of steam, which power it was proposed to apply to the working of dynamos sufficient to light a small area as an experiment. The Whitechapel Board will apply to the Board of Trade for a provisional order.

**Proposed Pacific Cable.** — The Montreal *Gazette*, of November 5th, calls attention to an error into which the *Globe* has fallen with regard to the originator of the trans-Pacific cable scheme. The *Globe* attributes the conception of the idea to Mr. Sandford Fleming, whose proposed route connected Canada with the Fiji and Sandwich Islands and Australia. Prior to this, however, it is stated that Mr. Gisborne, the Superintendent of the Dominion Government Telegraphs, had suggested a cheaper and better route *viâ* Japan and China. These views were published, accompanied by a chart explanatory of the various schemes, in the *Dominion Illustrated*, of 6th April, 1889. The main idea of Mr. Gisborne's route is apparently the connection with such industrially-important countries as Japan and China, instead of with unprofitable localities such as the Pacific Islands, and his scheme possesses the additional advantage of shorter sec tions than contained in either of the other routes advocated. As observed by the *Gazette*, priority of idea is not a matter of so much moment, excepting for the sake of such kudos as may be adjudged to the originator of the scheme. The important question is which of the proposed routes is most likely to find the greater number of supporters and the most influential partisans. There seems to be no great difficulty, other than from a financial point of view, attached to the carrying out of either of the suggested systems.

**Use of the Telegraph.**—Telegraph statistics for 1888 show that in the United Kingdom for every 100 inhabitants 140 telegrams were sent. France comes very close to this figure with 136 messages, but Germany is a long way behind with only 35. Italy follows with 20 telegrams, Austria-Hungary with 18, and Russia with only 2. "Is not the use of the telegraph," asks the *Lumière Electrique*, "a positive indication of the spread of civilisation, the progress of industries, and, to an extent, an estimate of intelligence?"

**Woodhouse and Rawson, Limited.**—On Tuesday a statutory meeting of the shareholders of this company was held at the offices in Bradford for the purpose of receiving an account of the reasons which led to the winding-up of the company, and passing a resolution of approval. Only three shareholders put in an appearance, namely, Mr. G. A. Steinthal, Colonel Harrison and Mr. J. Leach. Reporters were not admitted, and were informed that no statement of accounts would be supplied to them. A formal resolution of approval was, we understand, passed.

**Critical America.**—We notice in the New York *Electrical Engineer*, a leading article directed at our recent comments on the electro-deposition of copper. Were it not that such a thing seems impossible we should be apt to imagine that our contemporary had been inspired from this side, but we shall deal more fully with the criticisms of our American cousins in a future issue and endeavour to show that instead of being misleading, our deductions will be found correct even in trans-Atlantic eyes.

**Carbon Shields for Arc Lamps.**—If we are not very much mistaken, the Siemens's arc lamps of, say, 10 or 12 years ago, had a sheath on the lower carbon similar to that which Mr. Hazeltine employs on his upper electrode (see p. 643). Its object was, we believe, a different one; but it would be interesting to know whether any saving of carbon was effected by its use.

**Electrically-fired Mitrailleuses.**—To our readers who are connected with the War Office, the description of an electrically-fired Gatling gun will prove highly interesting, and it is more than probable that in the future there will be a great field for the employment of small electro-motors for such purposes on ship-board.

**Electric Supply Companies in Court.**—London Electric Supply Corporation *v.* Crookshank.—The plaintiffs, on Wednesday, sought to recover £167 for six months' supply of electric current to the Pall Mall Club. The plaintiffs' case was that when at the end of 1887 they had arranged to supply the club at £1 per 10-candle lamp, it was further agreed that the supply should eventually be by meter. They now claimed for six months' supply at meter value. The defendant denied having made any such agreement, and paid a sum into court on the old scale of charges.

His Lordship, in delivering judgment, said it was much to be wished that people would put their agreements into writing. The plaintiffs had no note or memorandum, and their evidence was of an exceedingly hazy character. They failed because of the careless manner in which they did business. He did not find that there was any agreement to pay by meter scale, and his judgment would be for the defendants with costs.

Dickens and Jones *v.* Metropolitan Electric Supply Company, Limited.—In this action, on the same day, Messrs. Dickens and Jones, of Regent Street, sought to recover damages for alleged breach of contract to supply electric light to their premises. The defendants denied that there was any written agreement, and pleaded alternatively that if they had entered into any agreement at all, it was an agreement at will only, and made subject to a proviso that the defendants were not to be liable to any damage by accidental interruptions. They pleaded that if the supply had been interrupted, it was accidentally, and by reason of the overhead wires being in an unsafe condition at a period when they could not enter upon the district in which the plaintiffs' premises were situate, for the purpose of replacing them. For the same reason they contended that they were prohibited from supplying the plaintiffs any longer, and only continued to do so by the sufferance of the Board of Trade. They stated, further, that when under the new regulations of the Board of Trade, consequent upon the new Electric Lighting Act, their supplying cable had become insufficient, they had written plaintiffs, offering to provide and fix suitable plant at their cost, which offer had been refused.

In reply, plaintiffs pleaded that, under Section 6 of the Act, defendants were permitted to continue supply until September 29th, 1890.

Evidence was given that, prior to 1888 the plaintiffs had been supplied by the Grosvenor Gallery, and subsequently by Messrs. Pritchett & Co., and that when the business was purchased by the defendant company the supply of electric energy was continued under a somewhat similar contract. It appeared, however, that though a draft agreement had been submitted to Messrs. Dickens and Jones by Messrs. Pritchett & Co., and that though the plaintiffs on taking over the business had sent defendants a printed form of agreement, neither had been signed, and Mr. Lumley Smith, for the defendant, submitted that there was no evidence of any express agreement, and that the electric energy had only been supplied and received at the respective wills of supplier and consumer, and could be terminated by either party without notice.

With this view Mr. Justice Stephen agreed. He nonsuited the plaintiffs, and granted a stay of execution for six days pending appeal.

**Forging Telegrams.**—Henry Ives, the clerk who was convicted at the last sessions of the Central Criminal Court of forging a telegram, to whose case we referred at the time, was on Wednesday last brought up for judgment. Mr. Purcell addressed the court on his behalf, and the Recorder sentenced him to nine months' imprisonment with hard labour, to date from the date of his conviction.

**Overhead Conductor Regulations.**—The memorials which have been sent to the Board of Trade by four important electrical firms are well-timed, but they might have been couched in more vigorous terms. It is almost time that the relations existing between the technical advisers to the Board and the electrical trades should be dealt with in a forcible manner.

**Fatal Electric Shocks.**—The opponents of electrical execution may perhaps change their views as to the *efficacy* of the method if they ponder for a while on the fatal accident which we record to-day in our "Communications from Austria-Hungary." There have been so many practically instantaneous deaths from electrical shocks accidentally contracted, that it seems too absurd to think that we shall have a repetition of the Kemmler affair as reported, although we have never been amongst those who gave credence to the harrowing details of that death-scene. The approaching end of the Japanese who now awaits the carrying out of a sentence similar to Kemmler's will probably settle once and for all the conflicting opinions which exist on the subject.

**The National Telephone Electrical Society (Midland Branch).**—The first meeting for the Session 1890–1 of this society met at Birmingham on Friday evening last (November 21st, 1890), when the President, Mr. Coleman, M.I.E.E., delivered a highly interesting address on "Telephony at the Present Time." There was a large attendance, members from outlying centres being present.

**The Royal Society.**—Last night Messrs. G. J. Burch and V. H. Veley were down for reading a paper on "The Variations of Electromotive Force of Cells consisting of Certain Metals, Platinum, and Nitric Acid."

**Electric Lighting by Gas Companies.**—It is said from March, 1889, to March, 1890, the American gas companies increased their ownership in the electric lights to the extent of almost 50 per cent.

**Electric Light Accidents in America.**—James Tucker, a foreman lineman of the East River Electric Light Company, while repairing wires in a New York street, fell upon the wires, and died shortly after.

An *employé* of the electric light company at San Francisco has received a shock which is calculated at fully 1,000 volts. The man escaped with his life, but his hands are burned to the bone.

**Lecture to Nurses.**—A lecture to nurses on medical applications of electricity (with demonstrations on living subjects) will be given on December 11th, by Mr. Newman Lawrence, at the Institute of Medical Electricity, 35, Fitzroy Square, W.

**Prospects of Electric Light in Paris.**—M. Fontaine thinks that in 1891 or 1892 the electric lighting in Paris will require for its production motive force equal, in round numbers, to 32,000 horse-power.

**Canadian Telephones.**—It is said that there are about 25,000 telephones in use in Canada, of which more than 20,000 belong to the Bell Telephone Company.

**Overhead Wires.**—The London County Council will shortly apply for leave to bring in a Bill for the regulation and control—and, if need be, removal—of overhead wires.

**The Woking Electric Supply Company.**—The directors are about to make a further issue of shares. There are to be 400 new shares of £5 each, issued for the purpose of providing a working capital. Several residents in the district have expressed a wish to become shareholders in the company, and the directors, realising the importance of obtaining local support, have decided to offer these shares in the first place in this locality only. The total capital authorised is £20,000.

**Provisional Orders.**—The London *Gazette* publishes notices of the corporate authorities of the following places who will shortly apply to the Board of Trade for provisional orders under the Electric Lighting Act:—Coventry, Southport, Ealing, Monmouth, Bolton, Kidderminster, Bromley, Croydon, Torquay, Chiswick, Stockport, Leamington, Weston-super-Mare, Cardiff, Canterbury, and Exeter. Scarboro' will apply for the renewal of an order already existing, and public companies will apply for power to supply the following places: Newcastle-upon-Tyne, Weybridge, Westminster, Norwich, Exeter and St. Luke's, Chelsea and St. George's, Hanover Square.

**The Electro-Harmonic Society.**—The amateur concert (ladies' night) will take place on Monday evening, December 8th, and the programme may be seen in our supplement. Members will note with great pleasure that Mrs. Alexander Siemens has again kindly consented to sing, and a new amateur violinist in the person of Mr. Theodor Raaschon, will appear for the first time, to play one of Vieuxtemps' most celebrated and exacting compositions. With the exception of the baritone, Mr. Gordon Heller, and the youthful humorist, Mr. F. Charlton Fry, a son of that well-known elocutionist Mr. Chas. Fry, the remaining solo artistes are more or less familiar. Instrumental music will be in the ascendancy, and no doubt a very enjoyable concert will result. We may add that Major-General Webber has for the second time kindly consented to preside.

**Theatre Lighting.**—The theory of safety from fire in the electric lighting of theatres and other public places has received another check. On Saturday night, during the performance at the Comedia Theatre in Madrid, before a full house, an alarm of fire was raised, and almost immediately the theatre was in complete darkness. A panic of the worst kind appeared imminent; but, fortunately, some candles were quickly lighted, and the presence of mind of some portion of the audience sufficed to allay alarm. It was soon found that the fire was confined to part of the wings of the stage, and was of little importance, and the audience vacated the theatre quietly, without accident. The origin of the fire appears to have been the accidental connection of two imperfectly covered wires, causing them to emit sparks, which ignited some light canvas in the side scenes.

**Failure of Electric Light at Leeds.**—The *Leeds Mercury* complains about the lighting of the Town Hall. It says: "Somehow the dynamo gets lame in its supply. Two or three of the lamps catch the current and give forth a small solar blaze, but the others are as dark as the moon on the obscure side."

**The Paris-London Telephone.**—At Paris, the apparatus in connection with the Paris-London telephone will be provisionally installed at the Bourse. The telephone will be available night and day, and also on Sundays.

**London County Council.**—At the meeting of the London County Council on Tuesday last, Mr. Basset Hopkins drew attention to the fire at the Grosvenor Gallery, and asked whether the fire was caused, as he had heard, by the over-heating of an electric wire. If this gentleman, along with others, would cease to accept newspaper reports as reliable on technical subjects, there would be fewer lost sheep in this world.

**Execution by Electricity.**—The Supreme Court of the United States has approved the judgment of the Circuit Court in the case of Shibuya Judiro, a Japanese, confined in Sing Sing jail under sentence of death by electricity.

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**City and South London Railway.**—A number of trains, each consisting of an electric locomotive and three carriages have been running regularly for some days on this railway, in order to educate the staff in the working of the electrical plant, the hydraulic lifts, and other matters which are peculiar to the undertaking. It is expected that the final inspection of the Board of Trade will take place within a few days, and that the line will then be open to the public. On Monday, the 24th inst., on the recommendation of the Prince of Wales, who recently inaugurated the completion of the undertaking, H.S.H. Prince Hermann of Saxe-Weimar privately visited the railway. He was accompanied by Major Cardew, representing the Board of Trade, and was met at the City Station by Mr. C. J. Mott, the chairman of the company; Mr. Greathead, the engineer; Mr. Jenkin, the general manager; and Mr. Basil Mott, resident engineer, and proceeded at once to the special train which was awaiting him at the King William Street terminus. There he was met by Mr. Wm. Mather, M.P., and Dr. Edward Hopkinson, and Mr. Grindle, the resident engineer of Messrs. Mather and Platt. The train rapidly made the journey to Stockwell, stopping at each of the immediate stations. At Stockwell, the boiler house, engine house, and carriage sheds were examined, and the electrical working was explained by Mr. Mather and Dr. E. Hopkinson. On the return journey the Prince expressed a desire to travel on the electrical locomotive, so as to more closely inspect its working. The Prince expressed himself as very much pleased and gratified with all he had seen.

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**Electric Tramways Abroad.**—The recent failure of the accumulator system on the Sandhurst-Eaglehawk Electric Tramway, Australia, though it is no doubt a blow against the method of traction, does not appear to be such a complete condemnation as might appear at first sight. In the *Argus* for September 30th, it is stated that the batteries were guaranteed to give a speed of 8 miles an hour on a *level road*; but that, unfortunately, there were several steep gradients in the line, reaching as much as 1 foot in 20 feet, the result being that an average of about 6 miles an hour only could be attained. If the circumstances as reported are correct, it is not surprising that failure was the result; it is only a wonder that the cars were kept running for the 94 days that they did. To attempt to work such heavy gradients with the power at command was the height of folly. For the colonies, generally, there appears a splendid opening for electric traction, as the streets are wide, and, as a rule, nearly straight, and, moreover, the traffic is not congested. For some streets, however, there seems to be a great objection to the overhead system, whilst the channel system cannot be used, owing to frequent flooding; probably, however, in view of the advantages of the method of traction, overhead wires may, after all, be allowed.

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**Electric Light in Barcelona.**—In a note of this subject on October 31st, we stated the *Los Anales de la Electricidad* looked unfavourably on a scheme of lighting at 10,000 volts. This voltage was a mistake, as the machines supplied by Woodhouse and Rawson United, Limited, are Ferranti machines, and only work at 2,400 volts. It is expected that the installation will be fitted up in about two months.

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**Royal Naval Exhibition, 1891.**—Firms intending to exhibit objects connected with the Royal Navy or Maritime interests are reminded that all applications must be made by November 30th.

**Seeing by Electricity.**—Coining new words is seldom a successful pastime, and no matter how reasonable a suggestion may be, a host of objectors is sure to spring up who find fault, generally from "pure cussedness," if for no other reason. The use of the word "telephane" is, of course, at once objected to, but the objector in suggesting "telope" is certainly not right, as "ope" represents nothing connected with the subject. The nearest in that direction would be "teleopt," from *optikos*, *i.e.*, pertaining to sight. "Telephane" is certainly euphonious, and its derivation from *phainein*, "to show," or *phanerous*, "visible," is etymologically correct.

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**Electric Light in Birmingham.**—Two public companies, the Birmingham Electric Supply Company and the Birmingham House-to-House Electricity Company, have applied to the Board of Trade for provisional orders enabling them to supply electricity for public and private purposes in that city.

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**A Storehouse of Knowledge.**—The November number of the Proceedings of the Physical Society contains a number of articles bearing on electricity, to wit:—"On a Carbon Deposit in a Blake Telephone Transmitter;" "The Villari Critical Points in Nickel and Iron;" "On the Shape of Movable Coils used in Electrical Measuring Instruments;" "Considerations on Permanent Magnetism;" "On the Results of Some Recent Magnetic Work;" "Galvanometers;" "On Huygens's Gearing in Illustration of the Induction of Electric Currents;" "On the Diurnal Variation of the Magnet at Kew;" "The Effect of Change of Temperature on the Villari Critical Point of Iron;" "Notes on Secondary Batteries."

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**Tenders Wanted.**—Tenders are required for electric lighting plant and machinery for Pretoria, in the South African Republic. Particulars will be seen in our advertisement columns.

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**Count Mattei Again.**—Under the heading of "People we Know," a weekly journal, which is claimed to have a certain status, holds forth as follows:—"Count Mattei, the famous Italian cancer curer, is now over two-and-eighty, but looks three decades younger, and, though he has lived for many years alone on the hills near Bologna, his manners are those of a polished man of the world. He says he owes his rugged health to the use of his famous electric globules, which he takes daily in his coffee, and which give the taker an imperceptible electric shock—the principle and secret that distinguish his medicines from homœopathy. He tells many stories of miraculous cures he has effected by the aid of his "blue electricity," and says that he owes its discovery to a mangy dog, which every day ate at the same plant in the woods. Before that time he had cured people of nervous disorders by putting them into a completely violet room, which, he declares, is most soothing to the nerves. By trying a decoction of the plant used by the dog, he was able to cure skin diseases. His great secret lies in the fixing of electricity in these decoctions; this secret nobody knows, not even his adopted son, and when the medicines are thus far prepared by other hands, he puts the supreme and finishing touch himself." In the words of a financial contemporary, we may say, "Lord, how long?" How long will such statements be scattered broadcast to delude the ignorant, and how long will papers continue to advertise these absurdities?

After referring to the visit of Mr. Stead to Count Mattei, for the purpose of writing an article in the next issue of the *Review of Reviews*, regarding the latter's "secret electricity," the *Star* states that "the electricity is taken internally."

**New Cable Across the North Sea.**—A new cable was completed last week for the Great Northern Telegraph Company, between Newbiggin (near Newcastle) and Marstrand (Sweden). The cable was manufactured by the Telegraph Construction and Maintenance Company, and laid by that company's vessel, the *Seine*. The work seems to have been carried out with very creditable despatch. The total length of cable specified amounted, we believe, to about 550 nautical miles, and comprised the following types:—Shore end: Inner sheathing, 12 galvanised iron wires, each 0·170 inches diameter; outer sheathing, 14 galvanised iron wires, each 0·300 inches diameter. Total weight about 15 tons per N.M. Heavy intermediate: 12 galvanised iron wires, each 0·300 inches diameter. Total weight about 10·5 tons per N.M. Intermediate: 12 galvanised iron wires, each 0·200 inches diameter. Total weight about 5 tons per N.M. Deep sea, No. 1: 12 galvanised iron wires, each 0·170 inches diameter. Total weight about 3·75 tons per N.M. Deep sea, No. 2: 17 galvanised homo wires, each 0·099 inches diameter. Total weight about 2·5 tons per N.M. The core is composed of seven strands of copper, weighing 180 lbs. per N.M., and 180 lbs. of gutta-percha. The foregoing figures are necessarily only approximate, and we are unable to state the quantity of each particular type manufactured or laid.

**"A Coming Man."**—The *London Figaro* gives a short biographical sketch of Mr. Greathead, the engineer of the South London Railway, under its series of "Coming Men." Considering that Mr. Greathead is a man who "has come," it appears that the *Figaro* might have reserved its space for somebody less well-known.

**Telephonic Appointment.**—The newly-licensed Mutual Telephone Company has just concluded an arrangement with Mr. A. R. Bennett, whereby he becomes their general manager and chief engineer for three years. Mr. Bennett has retained power to practise as a consulting electrical engineer, and will have his headquarters in London. It will be remembered that Mr. Bennett resigned his post of divisional general manager in Scotland to the National Telephone Company last July in consequence of disagreements with the directors who insisted upon reverting to methods of construction which he had abandoned years before as obsolete.

**Applied Classics.**—The *Daily Telegraph* asks, Do electrical engineers, as a rule, know their Latin grammar? If not, the Postmaster-General's so-called epigram at the Criterion Restaurant on Thursday evening must have been "caviare to the general." If, however, there did lurk within their scientific brains any memory of an early and effete classical education, they must have found it somewhat difficult to reconcile Mr. Raikes's paraphrase with the original. The point of the Latin lines is that the three-fold goddess has three distinct offices with three different weapons in three divergent regions. As Proserpine she scares the shades below with her sceptre, as Luna she lights the upper air with her beams, as Diana she drives the wild beasts with her arrow. If the application must be transferred to the various uses of the electric light, it might run somewhat as follows: "The Underground she lights upon its way (or rather she ought to, if only the Metropolitan Railway Company were sufficiently civilised), or helps the high-throned 'gods' to see the play, or drives the 'Bears' on 'Change to find their prey."

## OFFICIAL RETURNS OF ELECTRICAL COMPANIES.

**House-to-House Electric Light Supply Company, Limited.**—At an extraordinary general meeting of the members of this company, held at the Central Electric Lighting Station (Kensington), Richmond Road, S.W., on the 9th, it was resolved that £60,000 in 12,000 shares of £5 each, being part of the original capital, be issued as 7 per cent. cumulative preference shares, with a right of priority on any distribution of assets, and with the option of exchange of each preference for an ordinary share upon giving one month's notice. The resolution was confirmed on the 24th ult. and was registered 17th inst.

**Monte Video Telephone Company, Limited.**—The annual return of this company, made up to the 14th inst., was filed on the 17th inst. The nominal capital is £220,000 divided into 29,000 preference and 15,000 ordinary shares of £5 each. The shares taken up are 28,000 preference and 15,000 ordinary, 3,000 of each being considered as fully paid up. Upon 25,000 preference and 12,000 ordinary shares the full amount has been called, the calls paid amounting to £185,000.

**Northern Counties Electric Light and Power Company, Limited.**—The statutory return of this company, made up to the 9th inst., was filed on the 17th inst. The nominal capital is £1,000 in £1 shares, 100 of which are founders' shares; 7 founders' shares are taken up, upon which no call has been made. Office, 13, Victoria Street, S.W.

**Paddington and Bayswater Electric Light and Power Supply, Limited.**—The statutory return of this company, made up to the 9th inst., was filed on the 17th inst. The nominal capital is £1,000 in £1 shares, 100 of which are founders' shares; 7 founders' shares are taken up, but no call has been made thereon. Registered office, 13, Victoria Street, S.W.

**Electric and General Investment Company, Limited.**—The statutory return of this company, made up to the 30th September, was filed 10th ult. The nominal capital is £200,000, divided into 39,900 ordinary and 100 founders' shares of £5 each. The shares taken up are 10,000 founders' and 20,000 ordinary, and upon the former the full amount has been called, and upon the latter £1 per share has been called. The calls paid amount to £20,400, and unpaid to £100. Registered office, 1 and 2, Great Winchester Street.

**Yorkshire House-to-House Electricity Company, Limited.**—An agreement of 24th June, 1889, filed 20th inst.), with the House-to-House Electric Light Supply Company, Limited, provides for the allotment to that company of 100 fully-paid founders' shares in this company, in consideration of the payment of the preliminary expenses. The first director nominated by the House-to-House Company is Mr. Robert Hammond, who is to be paid £100 per annum of the £500 per annum set aside for minimum directors' fees.

**Western House-to-House Electricity Company, Limited.**—An agreement of 24th June, 1889 (filed 20th inst.), with the House-to-House Electric Light Supply Company, Limited, provides for the allotment of 100 founders' shares to that company, in consideration of the payment of preliminary expenses. Mr. Robert Hammond is appointed a director, and is to receive £100 per annum of the £500 per annum set aside for minimum directors' fees.

**South of England House-to-House Electricity Company, Limited.**—An agreement of 24th June, 1889, and filed 20th inst., with the House-to-House Electric Light Supply Company, Limited, provides for the allotment of 100 founders' shares to that company, in consideration of the payment of the preliminary expenses of this company, and also appoints Mr. Robert Hammond a director, at a remuneration of £100 per annum out of the £500 per annum set aside for minimum directors' fees.

**Scottish House-to-House Electricity Company, Limited.**—An agreement of 24th June, filed 20th inst., with the House-to-House Electric Light Supply Company, Limited, is similar in terms to the agreements of the three preceding companies.

**Northern House-to-House Electricity Company, Limited.**—An agreement of 24th June, 1889, filed 20th inst., is similar in terms to the four preceding companies' agreements.

**Midland House-to-House Electricity Company, Limited.**—An agreement of 24th June, 1889, filed 20th inst., with the House-to-House Electric Light Supply Company, Limited, is similar in terms to that entered into by the five preceding companies.

**Manchester House-to-House Electricity Company, Limited.**—An agreement of 24th June, 1889 (filed 20th inst.), with the House-to-House Electric Light Supply Company, Limited, is similar in terms to the foregoing.

**Liverpool House-to-House Electricity Company, Limited.**—An agreement of 24th June, 1889, with the House-to-House Electric Supply Company, Limited, is similar in terms to the foregoing.

**Lancashire and Cheshire House-to-House Electricity Company, Limited.**—An agreement of 24th June, 1889 (filed 20th inst.), with the House-to-House Electric Light Supply Company, Limited, is similar in terms to the foregoing.

**Irish House-to-House Electricity Company, Limited.**—An agreement of 24th June, 1889 (filed 20th inst.), with the House-to-House Electric Light Supply Company, Limited, is similar in terms to the foregoing.

**Birmingham House-to-House Electricity Company, Limited.**—An agreement of 24th June, 1889 (filed 20th inst.), is similar in terms with the agreement entered into by the preceding companies.

## CITY NOTES, REPORTS, MEETINGS, &c.

### The Electric Construction Corporation, Limited.

THE directors' report to be submitted to the shareholders at the ordinary general meeting to be held at Worcester House, Walbrook, London, E.C., on Monday, the 8th day of December, 1890, at 12 o'clock noon, shows a profit of £52,639 3s. 2d. It further states that this may be considered as eminently satisfactory, having regard to the facts that (1) the corporation did not enter into full possession of all the properties acquired until October 31st, 1889; and (2) the corporation has not during the past year had the benefit of the increased power and economy of production to be derived from the new Bushbury Works, to which special reference is hereafter made.

From the profit of £52,639 3s. 2d., the board have written off the whole of the preliminary expenses of the formation of the corporation, amounting to £4,348 7s. 6d., and they have also carried to capital account a considerable sum resulting from licenses and re-sales of patents. No patents have been sold or licenses granted which can, in the opinion of the directors, prejudice the profit-earning power of the corporation, and possibly a certain portion of the amount so applied to capital might have been regarded as divisible profits; but, having regard to the large amount of the capital of the corporation at present represented by patent rights, the directors are satisfied that the shareholders will support the more prudent policy which has been adopted.

From the profit balance of £48,290 15s. 8d. the directors recommend:—1. That the sum of £15,000 be placed to reserve account against depreciation. 2. That a dividend of 6 per cent. be declared and paid upon the capital which has been from time to time called up, and paid in respect of the ordinary shares of the corporation, from the date of allotment on the 7th day of June, 1889, to the 30th day of September, 1890, inclusive, carrying forward the balance to the current year's account.

At an early date after acquisition of the Elwell-Parker business, the directors satisfied themselves that the existing Wolverhampton (Commercial Road) Works were inadequate to cope with the large and increasing orders for electrical goods, and particularly for those of the heavier class now in demand for central stations. A very advantageous site was secured at Bushbury, near Wolverhampton, immediately adjoining and in direct communication with the London and North Western Railway Company. Works have been there erected which, it is believed, will enable the corporation to supply electrical work of any class; but, having regard to the manner in which the business of the corporation has developed, provision has been made for still further extensions, should the necessity arise. The cost of the construction of these works with the necessary land, sidings and machinery, has, of necessity, been great; but the directors are satisfied that the capital of the corporation has been well expended.

In the prospectus of the corporation, it was stated that "as the business and profits of the corporation increase the directors will from time to time propose the issue of additional capital, but care will be taken that the holders of the original capital shall be entitled to a preference or priority of allotment in subsequent issues." To secure the full advantage and profits of increasing business, it is desirable that a considerable addition should be made to the resources of the corporation. In the opinion of the directors a debenture issue would be more economical and advantageous to the present shareholders than an increase of capital either by ordinary or preference shares. Subject to any expression of opinion on the part of the shareholders at the general meeting, the directors therefore propose to make a sufficient debenture issue. Care will be taken that shareholders desiring to subscribe to these debentures shall have the opportunity of doing so.

In accordance with the articles of association, four of the directors, viz., Sir Daniel Cooper, with Messrs. Balfour, Courtenay and Dibley, retire from the board, all of whom are eligible, and offer themselves for re-election. The directors regret that the pressure of his professional engagements has compelled Sir Douglas Fox to resign his seat at the board. Sir Henry C. Mance, C.I.E., has consented to give the corporation the benefit of his great experience and scientific knowledge, as chairman of the board.

Messrs. Broads, Paterson & Co., the present auditors of the corporation, retire and offer themselves for re-election.

### Swan United Electric Light Company, Limited.

AN ordinary general meeting of the above company was held on Tuesday last at the Cannon Street Hotel, when the eighth annual report, which appeared in our last issue, was presented, and a balance of 10 per cent. for the year was declared.

The Chairman (Mr. J. S. Forbes), in the course of his remarks, said: The share capital of the company amounted to £375,000. Of this, £3,531 had been paid by people who had omitted to pay up their calls, and was consequently forfeited to the company. The cost of patent rights, &c., represented by shares in the Edison and Swan United Electric Light Company, was £208,478; shares in La Compagnie Générale des Lampes Incandescentes amounted to £30,489, and over and above those two solid assets there were patents held by the company for Germany, and other sources of income which were open to them as possessors of patent rights in England and abroad—outside of Europe. The absorption of the British business of the company by the Edison and Swan Company had been a very happy investment for them, as the bulk of the dividend which it was proposed to divide that day had come to them in respect of shares held in the Edison and Swan Company. Referring to the French Company, they had been in litigation with a powerful body of people in France—and France meant Russia, Austria, and other countries as well—for the Edison and Swan Company were doing in France what they had been doing in London, litigating the patents. They had thought it wise to avoid litigation among themselves and come to terms. A company was formed, a certain amount of money was subscribed by the two companies, and each was credited with a further sum in the nature of a goodwill. Out of Europe they had all the world—with some exceptions—which they could supply with lamps if they could find the customers. Referring to profit and loss, among other items was £26,733 due from sundry debtors, a large sum of money, but about £23,000 of it was dividend payable by the Edison Company to themselves. The older shareholders would remember that for some years no dividend had been paid, and, what was worse, the balance at the end of the year had been against the undertaking: they had determined as a matter of prudence to write down out of the profits of the following years all losses realised in the earlier years of the company. Their first balance to the good had been in 1887, in the following year they had had a further credit balance, but the proprietors had concurred with the directors in recommending that both amounts should be held in hand, and it was in 1889 that for the first time in the history of the company a dividend was distributed. The sums thus saved figured now in the balance sheet. The total outlay upon patent rights amounted now to £330,837 2s. 5d. They had been writing down their stock and plant very liberally for a number of years. They had an investment in the Prussian Consols, which the German Government had required them to deposit as a sort of caution money, and £29,004 19s. 6d. invested in the 2½ per cents. Cash on deposit and in hand amounted to £10,669 16s. Referring again to the item of stock, they had thought it prudent to write down stock approximately to the manufacturing price, because something might arise which would prevent the sale of a large stock of lamps at a much higher one, and lamps were put down at 10d. each which if sold for even so low a price as 1s. 6d. would leave a very large profit. Office expenses, &c., amounted to £3,513, and wages and expenses at factory to £5,000. On the other side of the account they would see among other figures the dividend on the shares in the Edison and Swan, £30,665 13s. 8d., which was quite 8 per cent. on the money invested with them. Those who had taken sufficient interest in the company, attended its meetings, and read its reports, knew that its future was likely to be fairly prosperous. They had protection for a certain number of years, but their policy was not founded upon protection. They hoped at the end of the protected period to have such a capacity, and such a *clientèle* that nobody should be able to work against them; but so long as protection lasted the dividend from the Edison and Swan Company might be looked for as a considerable one. The French

company had only just started, but already they had a very fine factory, though they had not succeeded so well as the English company in producing an efficient and economical lamp. It took a long time to get into the best groove, but they had all the advantage of the experience gained by the English company. Another difficulty of the French company was that they were still in litigation, and that a number of people took advantage of the fact to infringe their patents. Until the litigation was settled, too, they did not know the value of their business there. In Germany they were engaged in litigation with the Edison Company, and until the decision of the Supreme Court at Leipzic, to which they had appealed, was given, they would not know whether they had a right to make and sell their lamps in that country or not. The Chairman concluded by moving the adoption of the report, which was carried.

A few remarks by Mr. F. J. Mills were replied to by the Chairman, and the two retiring directors (Mr. F. R. Leyland and Mr. W. C. Quilter) were re-elected. The usual vote of thanks concluded the meeting.

## The Montevidean and Brazilian Telegraph Company, Limited.

AN extraordinary general meeting of this company was held at Langthorn House, on Tuesday, to receive special resolutions as to the winding up of the companies, and to consider an agreement made with the Western and Brazilian Telegraph Company for taking over the whole undertaking. The solicitor, having read the agreement,

The Chairman, in explaining the state of affairs, dwelt with satisfaction on the good bargain which he considered had been made. If anyone was inclined to cavil at the results of the working of the company, he would remind them that the present directors were not responsible, as when they came into office 15 or 16 years ago the affairs were in a very bad way. The first duty was to rescue the company from bankruptcy, and the secretary and himself had to assist the company by advancing a considerable sum of money to tide over difficulties. They had never been able to develop the resources of the company, because agreements with the Platino Company and the Western Brazilian Company bound them hand and foot. The speaker then referred to the agreement of 1885, which was drawn out, but was not finally accepted for some reason or other by the Western Company. Had this taken place at that time the property would have been secured on much better terms. On account of their own shares being now more valuable, a highly favourable arrangement had been made.

After further remarks the following resolutions were adopted :—

1. That the company be wound up voluntarily under the provisions of the Companies' Acts.

2. That George Fraser, F.C.A., be and he is hereby appointed the liquidator to conduct such winding-up.

3. That the agreement submitted to this meeting, dated 3rd November, 1890, and expressed to be made between this company of the one part, and the Western and Brazilian Telegraph Company, Limited, of the other part (being an agreement for the sale and transfer to the Western Company of the whole of this company's undertaking) be and the same is hereby approved. And that the liquidator be, and he is hereby authorised, in pursuance of Section 161 of the Companies' Act, 1862, and of all other powers enabling him in that behalf to carry said agreement into effect with such modifications (if any) as he may think expedient.

4. That the liquidator be and he is hereby authorised to receive, and when received to distribute amongst the holders of preferred shares in this company, the rent accruing to this company from the Western and Brazilian Telegraph Company, Limited, for the year ending 31st December, 1890.

A meeting to confirm the foregoing resolutions will be held in a fortnight's time.

## Blackpool Electric Tramway Company, Limited.

ANNUAL MEETING OF SHAREHOLDERS.

THE sixth ordinary general meeting of the members of the Blackpool Electric Tramway Company, Limited, was held at the Victoria Schools, Tyldesley Road, Blackpool, last Saturday afternoon. Mr. Alderman Richard Horsfall, J.P., C.E., F.S.I. (Halifax), chairman of directors, presided, and the following directors were present :—The Mayor of Blackpool (Mr. Alderman J. Bickerstaffe) ; Mr. T. H. Morris, J.P. (the Lodge, near Halifax), Vice-Chairman ; Mr. J. Broadbent (Manager), Blackpool ; Mr. G. H. Smith, Park House, Halifax ; Mr. John Oddie, Halifax ; Mr. Theodore Ormerod, Elm Royd, Brighouse, directors.

After the report had been read (an abstract of which appeared in the REVIEW last week),

The Chairman said it was his pleasure to meet them again as chairman of the Blackpool Electric Tramway Company, and to congratulate them, he thought, upon their balance-sheet. He did not know that he could say anything to them that day, excepting perhaps that they were working satisfactorily, all the machinery was in good working order, their furnaces were good, and that the directors felt that they came before the shareholders with a thoroughly sound and honest balance-sheet. (Hear, hear.) He had great pleasure in proposing the adoption of the report and balance-sheet as presented.

Mr. MORRIS (Vice-Chairman), in seconding the resolution, concurred in the remarks of the chairman. All their plant and property was in first-class order, while the prospects of the company, so far as they were able to judge, were never more satisfactory than at the present time. The dividend had been honestly and satisfactorily earned, and the amount put away for depreciation was felt to be needed for contingencies that might arise in the future.

The resolution was carried unanimously.

ELECTION OF DIRECTORS.—SOMETHING LESS THAN A COMPLIMENT.—AN OUTSPOKEN SHAREHOLDER.

Mr. Barcroft moved that the retiring directors, Messrs. Ormerod, Shaw and Smith be re-elected.

Mr. Hoyle : Does Mr. Holroyd Smith (patentee) ever attend ?

Mr. G. H. Smith : I am his brother ; he is not on the directorate.

Mr. Hoyle : Oh, that alters the case. I was going to ask him a question or two, for a more one-sided bargain, from first to last, I never came across than the one made by this company with the Blackpool Corporation. It is so bad in fact, that I consider it a positive disgrace, and I am ashamed to tell anybody about it. (Laughter.) It was the most one-sided business he had known "since he were created." (Loud laughter.) Was there any need to re-elect the three retiring directors ? He had been at meetings where he had heard of the directors of that company say that five directors were ample. He believed they could be too many.

Acting on a suggestion here, the attendances of the directors were read.

The Chairman said the meetings varied according to the season. He came down frequently, and if he thought it necessary to hold a meeting, one was called. There were no fixed dates for meetings. In answer to a question, the Chairman said they had two resident directors. Formerly they had three, but Dr. Kingsbury had sold out his shares.

Mr. Hoyle said he might say that he had so much confidence in the manager, that he believed if the directors never came but once a year that they would not be any worse off. (Laughter.) It was more a matter of form having them as directors than anything else, in his opinion. (Renewed laughter.) Only they were a large number ; whether they were all electricians or not he could not tell. No doubt all the shareholders would have been charged with something of the sort had there been no dividend for them. (Laughter.) He, however, had no objection to seconding the re-election of the three retiring directors. (Hear, hear.) Was it necessary to take the three together ?

The Chairman : You require to give seven days' notice before proposing a new director, according to the rules.

Mr. Hoyle : Are there articles of association ?

The Chairman : Yes.

Mr. Hoyle : I would be glad to have one and pay for it.

It was agreed to supply them to all shareholders at 1s. each copy.

Mr. Hoyle : I understand that at the end of seven years this concern can be taken from us by the corporation ?

The Chairman : The corporation can give us notice during the last term of the first seven years. On the other hand, if they do not take that course, we shall have to give them notice that we wish to continue in possession. Then the same routine is gone through at the end of 14 years, and then if we keep it for 21 years, we shall reach the expiration of the agreement. This fact accounts for the large sum put to depreciation—we are compelled to provide for the worst contingency.

Mr. Hoyle : If it is a good thing they can take it ?

The Chairman : Yes.

Mr. Hoyle : Then you may rely upon it they will take it. Blackpool people know a good thing when they see it, you may depend on that, and anything they can lay their hands on they will not let go past them. I have not much confidence in Blackpool people, I can tell you. I know them. (Laughter.)

The Chairman : If they take it they will have to pay for it.

Mr. Commissioner Buckley : Those who have got shares at a premium are likely to lose money by such an arrangement.

The Chairman : Well, I suppose they bought the shares for the dividends, and 7½ per cent. capitalised will make up the difference. Any shareholder who wishes to see the agreement between this company and the Corporation can do so only with the consent of the directors. This precautionary measure was necessary in the interests of the company.

The resolution was carried.

ELECTION OF AUDITORS.

Messrs. J. D. Taylor & Co., of Halifax, were reappointed auditors to the company, on the motion of Mr. Hoyle, seconded by Mr. Barcroft.

After further remarks and a vote of thanks to the directors, the meeting terminated.

## TRAFFIC RECEIPTS.

The Western and Brazilian Telegraph Company, Limited. The receipts for the week ending November 21st, after deducting the fifth of the gross receipts payable to the London Platino-Brazilian Telegraph Company, Limited, were £4,421.

The Brazilian Submarine Telegraph Company, Limited. The traffic receipts for the week ending November 21st were £4,637.

## SHARE LIST OF ELECTRICAL COMPANIES.

| Present Amount Issued. | Name. | Stock or Share. | Closing Quotation. (November 20.) | Closing Quotation. (November 27). | Business done during week ending November 27, 1890. Highest. | Lowest. |
|---|---|---|---|---|---|---|
| 250,000*l* | African Direct Telegraph, Ltd., 4 p. c. Deb. Regd. and to Bearer | 100 | 97 —100 | 98 —101 | 99½ | ... |
| 1,381,380*l* | Anglo-American Telegraph, Limited ... ... ... ... | Stock | 48 — 49 | 48⅛— 49⅛ | 49½ | 48½ |
| 2,809,310*l* | Do. do. 6 p. c. Preferred ... ... ... ... ... ... | Stock | 84 — 85 | 85 — 86⅛ | 85⅞ | 84½ |
| 2,809,310*l* | Do. do. Deferred ... ... ... ... ... ... ... | Stock | 12⅜— 13¼ | 13¼— 13⅜ | 13⅜ | 13 |
| 130,000 | Brazilian Submarine Telegraph, Limited ... ... | 10 | 10¾— 11¼ | 11⅛— 11⅜ | 11⅛ | 11 |
| 84,500*l* | Do. do. 5 p. c. Bonds... ... ... ... ... | 100 | 101 —103 | 101 —103 | | |
| 75,000*l* | Do. do. 5 p. c. 2nd Series, repayable June, 1906 | 100 | 104 —108 | 104 —108 | | |
| 63,416 | Brush Electric Engineering Ordinary, Nos. 1 to 63,416... ... | 3 | 1⅛— 1⅜ | 1 — 1⅛ | 1⅛ | ... |
| 63,416 | Do. do. Preference, Nos. 1 to 63,416 ... | 2 | 1½— 2 | 1¼— 1⅝ | | |
| $7,216,000 | Commercial Cable, Capital Stock ... ... ... ... ... | $100 | 102 —104 | 102 —104 | 103½ | 102 |
| 224,850 | Consolidated Telephone Construction and Maintenance, Ltd. ... | 14/- | 7/16— 9/16 | 7/16— 9/16 | | |
| 20,000 | Crompton & Co., Limited, 7 p. c. Pref. Shares, Nos. 1 to 20,000 | Stock | 5½— 5⅝ | 5½— 5⅝ | | |
| 16,000 | Cuba Telegraph, Limited ... ... ... ... ... ... | 10 | 11¼— 12 | 11⅛— 12 | 11⅞ | 11¼ |
| 6,000 | Do. do. 10 p. c. Preference ... ... ... | 10 | 17 — 18 | 17 — 18 | 17⅞ | 17½ |
| 12,931 | Direct Spanish Telegraph, Limited ... (£4 only paid) | 5 | 3¾— 4¼ | 3¾— 4¼ | | |
| 6,000 | Do. do. 10 p. c. Preference ... ... ... | 5 | 8⅜— 9⅛ | 8⅛— 9⅜ | | |
| 60,710 | Direct United States Cable, Limited, 1877 ... ... ... | 20 | 9⅛— 10⅛ | 10 — 10¼ | 10¼ | 10 1/16 |
| 400,000 | Eastern Telegraph, Limited, Nos. 1 to 400,000 ... ... ... | 10 | 13⅜— 13⅝ | 13⅜— 14¼ | 14 | 13⅜ |
| 70,000 | Do. 6 p. c. Preference ... ... ... ... | 10 | 14¼— 15½ | 14⅛— 15 | 14 15/16 | 14 |
| 200,000*l* | Do. 5 p. c. Debs. (1879 issue), repay. Aug., 1899 | 100 | 106 —109 | 106 —109 | 105½ | ... |
| 1,200,000*l* | Do. 4 p. c. Mortgage Debenture Stock ... ... | Stock | 103 —106 | 103 —106 | 105⅛ | 104½ |
| 250,000 | Eastern Extension, Australasia and China Telegraph, Limited | 10 | 13¾— 14 | 13⅜— 14 | 14 | 13⅞ |
| 320,000*l* | Do. 6 p. c. Debentures, repay. February, 1891 ... ... | 100 | 100 —102 | 100 —102 | | |
| 91,800*l* | Do. 5 p. c. (Aus. Gov. Sub.), Deb., 1900, red. ann. drgs. reg. 1 to 1,049 3,976 to 4,326 | 100 | 102 —105 | 102 —105 | 101½ | ... |
| 325,200*l* | Do. do. Bearer Nos. 1,050—3,975 and 4,327—6,400 ... | 100 | 102 —105 | 102 —105 | 104½ | 103½ |
| 145,300*l* | Eastern and South African Tel., Ld., 5 p. c. Mort. Deb., 1900 redeem. ann. drawings, Registered Nos. 1 to 2,343 | 100 | 101 —104 | 101 —104 | | |
| 198,200*l* | Do. do. do. to bearer, Nos. 2,344 to 5,500 | 100 | 101 —104 | 101 —104 | | |
| 45,000 | Electric Construction, Limited, Nos. 101 to 45,100 ... ... | 10 | 8 — 8⅛ | 7⅞— 8⅛ | 8⅛ | ... |
| 19,900 | *Electricity Supply Co. of Spain, Nos. 101 to 20,000 ... | 5 | 4⅜— 5⅛ | 4⅜— 5⅛ | | |
| 70,000 | Elmore's Patent Copper Depositing, Ltd., Nos. 1 to 70,000 ... | 2 | 3¾— 4¼ | 3¼— 4 | 4¼ | 3 15/16 |
| 67,385 | Elmore's Wire Manufacturing, Limited, Nos. 1 to 67,385 issued at 1 pm. all paid ... ... | 2 | 1¾— 2¼ | 1¾— 2¼ | 2 1/16 | ... |
| 20,000 | Fowler-Waring Cables, Nos. 301 to 20,000 ...(£4 only paid) | 5 | 2¼— 3½ | 2¼— 3¼ | | |
| 180,227 | Globe Telegraph and Trust, Limited ... ... ... ... | 10 | 9 — 8 13/16 | 8⅞— 9⅛ | 8⅞ | 8 9/16 |
| 180,042 | Do. do. 6 p. c. Preference ... ... ... | 10 | 14⅜— 14⅝ | 14⅜— 15 | 14⅞ | 14⅛ |
| 150,000 | Great Northern Tel. Company of Copenhagen ... ... ... | 10 | 15⅜— 16¼ | 15⅜— 16¼ | 16¼ | 15⅝ |
| 15,000*l* | Do. do. 5 p. c. Debs. (issue of 1881) ... | 100 | 101 —104 | 101 —104 | | |
| 230,000*l* | Do. do. do. (issue of 1883) ... | 100 | 104 —107 | 104 —107 | 106 | 104½ |
| 9,384*l* | Greenwood and Batley, Ltd., Ordinary, Nos. 4,667 to 14,000 ... | 10 | 11½— 12½ | 11½— 12½ | 12 | 11⅝ |
| 5,334*l* | Do. 7 p. c. Cumulative Preference, Nos. 2,667 to 8,000 | 10 | 11½— 12½ | 11½— 12½ | | |
| 41,800 | India-Rubber, Gutta-Percha and Telegraph Works, Limited ... | 10 | 18 — 19 | 18 — 19 | 18⅜ | ... |
| 200,000*l* | Do. do. 4½ p. c. Deb., 1896... ... ... | 100 | 100 —102 | 100 —102 | | |
| 17,000 | Indo-European Telegraph, Limited... ... ... ... ... | 25 | 35 — 37 | 35 — 37 | 36½ | 36¼ |
| 11,334 | International Okonite, Ltd, Ordinary Nos. 22,667 to 34,000 (£7 pd.) | 10 | 6½— 7 | 6⅛— 7⅛ | | |
| 11,334 | Do. do. Preference Nos. 5,667 to 17,000 ... | 10 | 6⅛— 7 | 6⅛— 7⅛ | | |
| 38,348 | London Platino-Brazilian Telegraph, Limited ... ... ... | 10 | 6 — 7 | 6 — 7 | | |
| 100,000*l* | Do. do. do. 6 p. c. Debentures ... | 100 | 105 —108 | 105 —108 | | |
| 43,900 | *Metropolitan Electric Supply, Limited, Nos. 6,101 to 50,000 £8 pd. | 10 | 6⅛— 6⅜ | 6⅜— 7⅛ | 6⅞ | 6⅛ |
| 438,984 | National Telephone, Limited, Nos. 1 to 438,984 ... ... ... | 5 | 4⅛— 4⅜ | 4⅛— 4⅜ | 4 13/16 | 4⅛ |
| 15,000 | Do. 6 p. c. Cum. 1st Preference ... ... ... | 10 | 12½— 12⅝ | 12½— 12⅝ | 12 7/16 | ... |
| 15,000 | Do. 6 p. c. Cum. 2nd Preference (£8 only paid) | 10 | 9½— 10½ | 9½— 10½ | 10 | ... |
| 220,000 | Oriental Telephone, Ltd., Nos. 80,001 to 300,000 (11/- only paid) | 1 | ⅛— ¼ | ⅛— ¼ | | |
| 9,000 | Reuter's, Limited ... ... ... ... ... ... ... | 8 | 8¼— 8⅜ | 8⅛— 9 | 8 11/16 | 8¼ |
| 209,750 | South of England Telephone, Ltd., Ordinary, Nos. 1 to 2,000, 2,501 to 3,500, 93,251 to 300,000 | 1 | ⅛— ¼ | ⅛— ¼ | | |
| 20,000 | Do. 6 p. c. Cum. Pref., Nos. 1 to 20,000 (£3¼ only paid) | 5 | 2½— 3 | 2½— 3 | | |
| 3,381 | Submarine Cables Trust ... ... ... ... ... ... | Cert. | 113 —117 | 113 —117 | | |
| 78,949 | Swan United Electric Light, Limited ... (£3½ only paid) | 5 | 5 — 5⅛ | 4½— 5 xd | 4 15/16 | 4⅞ |
| 37,350 | Telegraph Construction and Maintenance, Limited ... ... | 12 | 43 — 45 | 43 — 45 | 44½ | 43½ |
| 150,000*l* | Do. do. do. 5 p. c. Bonds, red. 1894 | 100 | 100 —102 | 100 —102 | 100¾ | .. |
| 58,000 | United River Plate Telephone, Limited ... ... ... ... | 5 | 3 — 4 | 3 — 4 | | |
| 146,128*l* | Do. do. 5 p. c. Debenture Stock... ... | Stock | 90 — 95 | 90 — 94 | | |
| 3,200*l* | Do. do. 7 p. c. Debs., Nos. 1 to 1,000 ... | 100 | ... ... | ... ... | | |
| 15,809 | West African Telegraph, Limited, Nos. 7,501 to 23,109 ... ... | 10 | 8½— 9¼ | 8½— 9½ | | |
| 290,900*l* | Do. do. do. 5 p. c. Debentures ... ... | 100 | 98 —101 | 98 —101 | | |
| 30,000 | West Coast of America Telegraph, Limited ... ... ... | 10 | 4 — 5 | 4 — 5 | | |
| 150,000*l* | Do. do. do. 8 p. c. Debs, repay. 1902 ... | 100 | 102 —107 | 102 —107 | | |
| 64,174 | Western and Brazilian Telegraph, Limited ... ... ... | 15 | 10½— 11 | 10½— 11 xd | 11⅛ | 10 15/16 |
| 27,873 | Do. do. do. 5 p. c. Cum. Preferred ... ... | 7½ | 6⅝— 6⅞ | 6⅛— 6⅝xd | 6⅞ | 6 |
| 27,873 | Do. do. do. 5 p. c. Deferred ... ... ... | 7½ | 4½— 5 | 4½— 5 | 4⅝ | ... |
| 200,000*l* | Do. do. do. 6 p. c. Debentures "A," 1910... | 100 | 103 —106 | 103 —106 | | |
| 250,000*l* | Do. 6 p. c. Mort. Debs., series "B" of '80, red. Feb., 1910 | 100 | 103 —106 | 103 —106 | | |
| 88,321 | West India and Panama Telegraph, Limited ... ... ... | 10 | 3 — 3¼ | 2⅞— 3⅛ | 3⅛ | 2 15/16 |
| 34,563 | Do. do. do. 6 p. c. 1st Preference ... | 10 | 11¼— 11⅝ | 11¼— 11⅝ | | |
| 4,669 | Do. do. do, 6 p. c. 2nd Preference ... | 10 | 11 — 12 | 11 — 12 | | |
| 1,336,000 | Western Union of U.S. Tel., 7 p. c. 1st Mort (Building) Bonds | $1,000 | 120 —125 | 120 —125 | | |
| 175,100 | Do. do. 6 p. c. Sterling Bonds ... ... ... | 100 | 99 —103 | 99 —103 | 100¼ | 100¼ |
| 42,853 | *Westmstr. Elec. Sup. Corp., Ord., Nos. 101 to 42,953 (£3 only paid) | 5 | 2⅛— 3 | 2⅛— 2⅜ | | |

* Subject to Founders Shares.

### LATEST PROCURABLE QUOTATIONS OF SECURITIES NOT OFFICIALLY QUOTED.

Blackpool Electric Tramway Company, Limited, £10 (£6½ paid), 7⅛—7⅜.—Elmore Copper Depositing Priorities, 7 —7¼.—Elmore's French Patent Copper Depositing shares of £2 (issued at 10s. premium, £1 10s. paid, including premium), 2—2¼.—House-to-House Company (£5 paid), 4¾—5¼.—London Electric Supply Corporation, Ordinary (£5 paid), 1⅝—2⅛.—Manchester Edison and Swan Company, £9 (£1 paid) 11/- —13/-.—Woodhouse & Rawson Ordinary of £5 (£2 10s. paid), 2¼—⅜.—Preference, 4⅛—4½.

BANK RATE OF DISCOUNT.—6 per cent. (7th November 1890).

## ITALIAN TELEGRAPH STATISTICS.

THE following statistics are compiled from a recent official return regarding the position of telegraphy in Italy from July, 1888, to June, 1889:—

*Telegraph Lines.*

| | |
|---|---|
| Length in miles ... ... ... | 21,647 |
| Length exclusively for railway service | 1,424 |
| Mileage of wires ... ... ... ... | 61,455 |
| Mileage of wires for railway use ... | 19,279 |

*Telegraph Offices.*

| | |
|---|---|
| State offices ... ... ... ... | 2,437 |
| Railway and private offices ... ... | 1,369 |
| Various ... ... ... ... ... | 40 |

*Telegraph Apparatus.*

| | |
|---|---|
| Morse type ... ... ... ... | 3,789 |
| Hughes „ ... ... ... ... | 101 |
| Various „ ... ... ... ... | 63 |

*Personnel.*

| | |
|---|---|
| Central office ... ... ... ... | 213 |
| Other offices ... .. ... ... | 7,036 |

*Home Telegrams.*

| | |
|---|---|
| Subject to taxes ... ... ... ... | 6,364,212 |
| Despatched by the railways ... ... | 713,797 |
| Exempt from taxes ... ... ... | 583,246 |

*International Telegrams.*

| | |
|---|---|
| Sent abroad ... ... ... ... | 646,980 |
| Received from abroad ... ... ... | 773,829 |
| „ in transit ... ... ... | 131,482 |
| Service messages ... ... ... ... | 216,860 |

*Receipts.*

| | |
|---|---|
| Home messages ... ... ... ... | £409,374 |
| Foreign „ ... ... ... ... | 147,328 |
| Various „ ... ... ... ... | 32,987 |

*Expenses.*

| | |
|---|---|
| Extraordinary: new offices, &c. ... | £23,979 |
| Ordinary staff expenses ... ... ... | 345,682 |
| Maintenance, &c.... ... ... ... | 166,133 |

## DINNER OF THE INSTITUTION OF ELECTRICAL ENGINEERS.

THE second annual dinner of the Institution of Electrical Engineers was held last Thursday evening at the Criterion Restaurant, Dr. John Hopkinson, F.R.S., President, in the chair. About 200 gentlemen sat down to table, and among them were:—The Right Hon. H. C. Raikes, M.P. (Postmaster-General); Mr. Latimer Clark, F.R.S. (past president); Sir R. E. Webster, Q.C., M.P. (Attorney-General); Prof. G. Carey Foster, F.R.S. (past president); Mr. G. Berkley (vice-president Institution of Civil Engineers); Prof. W. Grylls Adams, F.R.S. (past president); Mr. W. H. M. Christie, F.R.S. (Astronomer-Royal); Mr. Edward Graves (past president); Prof. J. J. Thomson, F.R.S.; Sir Douglas Galton, K.C.B., F.R.S., D.C.L.; Major F. A. Marindin, R.E. (Inspector of Railways, Board of Trade); Major P. Cardew, R.E.; Sir Albert Cappel, K.C.I.E.; Sir Henry Mance, C.I.E.; Mr. Gisbert Kapp; Sir George Gabriel Stokes, M.P. (President Royal Society); Mr. W. H. Preece, F.R.S. (past president); Mr. J. Tomlinson, jun. (President Institution of Mechanical Engineers); Major-General Webber, C.B. (past president); Sir R. Rawlinson, K.C.B. (Vice-President Institution of Civil Engineers); Mr. C. E. Spagnoletti (past president); Prof. Dr. Coleman Sellars (member of the International Niagara Commission); Prof. D. E. Hughes, F.R.S. (past president); Sir Stevenson Arthur Blackwood, K.C.B. (Secretary General Post Office); Sir David Salomons (member of council); Captain W. J. L. Wharton, R.N., F.R.S. (hydrographer to the Admiralty); Sir James N. Douglass, F.R.S. (member of council); Sir James Anderson (member of council); Sir H. Trueman Wood (Secretary Society of Arts); Prof. S. P. Thompson, B.A., D.Sc. (member of council); Colonel R. Raynsford Jackson (member of council); Captain Stiffe; Mr. R. E. Crompton (vice-president); Herr Fritsche; Dr. Fleming; Mr. J. W. Swan; Mr. Bidwell, F.R.S.; Staff-Commander E. W. Creak, R.N.; Mr. W. Crookes (vice-president); Mr. J. C. Lamb, C.M.G.; Major-General Stotherd, C.B., R.E.; Prof. George Forbes, F.R.S.; Prof. W. E. Ayrton, F.R.S. (vice-president); Prof. W. C. Unwin, F.R.S.; Mr. Gordon; Mr. Alexander Siemens (vice-president); Mr. F. H. Webb (secretary); and Mr. F. H. Webb, jun.

The PRESIDENT, in proposing the "Army and Navy," said he could have wished that this toast had been consigned to abler hands, but the committee who had arranged the toasts had insisted that it was the duty of the President to propose the major portion of them, and he had to give way. If there was any one profession to which electrical engineers were indebted more than to any other it was the profession of arms. The telegraph was the nervous system of the army in the field, the application of electricity to explosions and to submarine minings was a necessity, and the largest arc lights, as they knew, were those which were employed observing the approach of hostile torpedoes; while, further, if the nation were not ready to repel aggression by force of arms, the enormous system of submarine telegraphs could hardly exist. He coupled with the toast the name of General Stotherd, who, as they knew, paid considerable attention to field telegraphs, and who was also head of the ordnance survey. With the toast of the navy he coupled the name of his friend, Captain Wharton, who was best known in connection with the more peaceful functions of the navy.

General STOTHERD spoke of the enormous sums of money spent in order to bring the army and navy to that state of efficiency which has been necessary of late years. When he was at Chatham, nearly 20 years ago, he had the pleasure of organising the field telegraphs, also the system of submarine mines, which had since been adopted. The gallant gentleman referred to the extensive use of the telegraph in the last Russian campaign, and averred that in the wars in the Soudan and South Africa the extensive operations could not have been carried out without it. While speaking of the electric telegraph, he drew attention to the extensive reserve in connection with field telegraphy in the Post Office. By means of that reserve they had been able recently to enter upon—and without difficulty to carry on—operations simultaneously in the Soudan and in South Africa. With regard to submarine mines, they had not yet, he was glad to say, had any opportunity of trying what they could do in war, and, indeed, he sincerely hoped they would never have to use them. Many people were averse to them because they thought merchant vessels would be prevented coming into port; but he entirely disagreed with them. The system was so arranged that there would be no difficulty whatever.

Mr. RAIKES, in returning thanks, said: Mr. President and Gentlemen, it is, I am aware, no small honour to return thanks for the toast of ,Her Majesty's Ministers in such a company and on such an occasion. And yet I feel some little diffidence in addressing myself to the task when I remember that it has been previously performed by no less a person than the head of the present Government, the Marquis of Salisbury, and he is not only the head of the Government, but he is, what I cannot pretend to be, a somewhat expert electrician. I have also near me another friend of mine, who likewise belongs to her Majesty's Government, the Attorney-General, who is known to many gentlemen here not less as an electrical expert than as a profound lawyer; and on one very important occasion, when I had recourse to his advice, I found that, in my opinion, his electricity was as good as his law. (Laughter.) At all events, his electrical skill enabled us to steer out of a difficulty which otherwise might have required us to apply to his law. (Laughter.) It is no doubt a fact that the department which I am called on to preside over has closer relations with electrical engineering than perhaps any other of the great departments of the State. It is not necessary that I should refer in detail to the enormous amount of telegraphic business which has grown up in the 19 years during which the department of the Post Office has been charged with its administration in this country. But it is probably interesting to know that in that time the number of telegrams has grown from 10,000,000 in 1871 to 62,500,000 in 1889 that is to say, it has sextupled in the course of those 18 years. You will easily understand how important it is for our department to be *au courant* with all the latest developments of electrical science and the wonders of electrical skill. It is not without feelings of pride that I recall the fact that the Post Office has given to this institution three of its presidents—Mr. Scudamore, Mr. Preece, and Mr. Graves—for all of them occupied the chair which you, Mr. President, now fill; and I am happy to think that they have been able to render great service to the science of electricity at the same time that they have not thereby been induced in the smallest degree to neglect their public duty to the department which they so efficiently served. But it is not the Post Office alone of Government departments which has relations with electrical engineering. Second to the Post Office, if indeed second, is the Board of Trade in relation to your science. The Board of Trade has special charge of lighthouses, and the Board of Trade has had the opportunity of testing and of specially utilising more than one of the considerable discoveries of your president in that branch of electric science. We can only regret that in the neighbouring country of Spain, on whose shores that terrible catastrophe happened the other day, there is not, as far as I am aware, either a Board of Trade or an Institution of Electrical Engineers. If they had the advantages which we possess, we might hope and believe that the lights at Cape Villano might have been in such a state as to prevent the loss of that good ship and of those brave lives that went down into the deep. The Board of Trade is not only interested in lighthouses, but also in the great question of electric lighting. I know that a great many gentlemen, and perhaps a majority of those present, are of opinion that electric lighting has been unduly arrested by the jealousy of Parliament, or of departments of the Government. I understand that feeling, but I do not share it. When you have a young science, it is desirable to give that science time to feel its feet, and in some way appreciate what it can do before you rush headlong into employing it. I cannot but think that Parliament has been wise in holding

its hand for some years before taking any decisive steps for licensing and extending the use of the electric light, because it has no doubt given time for experiments to greatly improve the science, and to secure for the public, now that they are beginning to make use of it, a very much better article in the way of electric light than they would have done had they rushed blindly into it eight or ten years ago. The Board of Trade has another connection with electrical engineering—with respect to electricity as a motive force. The recent opening of the new subterranean railway in South London has given us all an opportunity of testing, by actual experience, how this most interesting experiment will work, and it will be the special duty of the Board of Trade to keep its eyes open, to study the working of the new system, and report upon it in an independent way, which will enable the public generally to judge for themselves how far that experiment may be imitated elsewhere. Then the Admiralty has its relations with electrical engineering, because day by day it is becoming more and more necessary to have recourse to electricity in handling those great monsters of the deep, which are the fighting ships of our day, and are so ponderous and unwieldy, that ordinary skill might be powerless to handle them. The War Office, too, as you know, is also dependent on electrical engineering, for no man nowadays could take the field for a campaign unless he had obtained the best means for the supply of information, both from the front to headquarters and from headquarters to the front. Therefore you see all those departments of the State are separately very much beholden to the electrical engineers. It is on behalf of them all that I address you this evening and tender to you the grateful thanks of her Majesty's Ministers for the great services you have rendered to them. It is almost impossible, in dealing with the operations of a body like this, to over-estimate the enormous changes which through your instrumentality are affecting our daily life. I am not going to say, as I believe some enthusiasts say, that you have actually annihilated time and space, but you have so far modified time and space that it is impossible for those who live in this day to attach to those words anything like the sense in which they were used in the preceding generation. You are perpetually finding out new fields. It is not merely that you have covered all these grounds, but you are making for yourselves a great field in manufactures; and even in the healing art electricity is coming to play a very important part. Not only may a man be taken to his business in the morning by electricity, not only may he see his manufactory conducted by electricity, but he may have the advantage of having his tooth taken out by electricity if he has any weakness of that kind. It is impossible to forecast the enormous future before this particular branch of science. You seem to have taken to yourselves the attributes of the whole of that Pantheon, the whole of those influences which in ancient days were supposed to dominate our sublunary life. But if I had to single out among those mythological deities any one which might seem more appropriately to be the patron or patroness of your science, I would say that you seem to me to have borrowed in a special degree the attributes of that goddess who, we remember—probably those of us who still retain the rudimentary features of our school training—adopted a threefold name and a threefold aspect. If you will permit me, I will conclude with those two lines with which our Latin grammar has made us familiar:—

> "Terret, lustrat, agit Proserpina, Luna, Diana,
> Ima, suprema, feras, sceptro, fulgore, sagittâ."

As I was coming down here I thought I might perhaps venture to string together this little paraphrase of those lines:—

> "Our threefold goddess, with her magic spells,
> By turns alarms, enlightens, and impels,
> While hangs the pale exchange upon her strings,
> Her lamp cheers cities, and her touch gives wings."

Mr. LATIMER CLARK, Past-President, in proposing "The Learned Societies," said it was unnecessary for him, in a meeting such as this, to give any commendation or recommendation to that toast. They knew perfectly well what the learned societies had done for them and for science; they knew they had given lustre to the times in which they lived. They had to a large extent, perhaps, created benefits to the electrical engineers greater than to any other body of men. They—the electrical engineers—had received from those societies, to a very large extent, the laws which enabled them to know the behaviour of that singular agent, or fluid, or force with which they had to deal. But the learned societies had a yet higher claim upon their respect and admiration. The learned societies of this and other countries had been able to pursue not only the love of science and the desire to gain knowledge, they had also been able to attain, or to endeavour to attain, to absolute truth; and, so far as he knew, no other human agency sought that truth from such pure motives as the learned societies. Whatever might be the consequence of those researches, they sought truth and truth only. He therefore proposed this toast, coupled with the name of the President of the Royal Society, Sir George Stokes.

Sir GEORGE STOKES, in responding, said the toast of "The Learned Societies" was a very wide subject, if they took in all the institutions which deserved that name. From the nature of those institutions, and from the speech of the gentleman who proposed that toast, he supposed it was not meant to include in that term literary and philological societies, but to confine themselves more especially to scientific societies; though here the field was somewhat limited, because there was another toast which would be proposed in due time—the kindred societies—societies kindred to the Electrical Engineers. It was quite true that there were societies who had claims to abstract discovery of scientific truth, apart from its applications. These discoveries, he had no doubt, formed the groundwork of subsequent applications, and there were many such societies, due to particular branches of science, with which electrical engineering was brought more especially into contact. It was brought into contact even with abstract mathematics. It was brought into contact, again, with chemistry, that strange agent which they had to deal with and turn so much to practical account, for electricity, as they knew, was intimately bound up with chemistry. Circumstances at the present led him to look more to the future than to the past. No doubt his name had been connected with this toast in consequence of the honourable office which for the present he was filling; but his tenure of that office was now drawing to a close, and in a few days he would cease to hold it. Perhaps he ought not to name his successor, because that was determined by the votes of the fellows, and those votes were given by ballot; yet he thought it was what he could call an open secret that in all human probability his successor would be one who, though somewhat his junior in age, he could look up to as his master in science, and more especially in electricity. He was one well acquainted with them, and he had already filled the position which his friend on the right occupied at that very moment. With that he would say no more.

Mr. W. H. PREECE proposed "The Kindred Societies," and said that there was every reason to hope that the next President of the Royal Society would be Sir William Thomson.

Mr. GEORGE BERKLEY, Vice-President of the Institution of Civil Engineers, responded, and referred to the cordial intercourse which existed between American Engineers and those of this country, pointing out that after a visit to the United States one came back with the feeling that this country was somewhat behind in adopting the advantages which electricity conferred.

The PRESIDENT proposed "Our Guests." Referring to the Attorney-General, he said that there was no one by whom it was more pleasant to be examined in cross-examination; but, whether as friend or as foe, in time one's admiration for his strength and judgment was almost overshadowed by a respect for his honesty of purpose and firmness. They would also find that the honourable and learned gentleman knew a great deal about electricity, and that he had consented to join the institution. Their other guest was Dr. Coleman Sellers, member of the International Niagara Commission, who having attained to the highest eminence in other branches of science, was considering the problem of utilising to a useful purpose part of the vast energy which was going to waste in the falls of Niagara.

The ATTORNEY-GENERAL on rising was received with loud applause. He said: Mr. Chairman and Gentlemen,—I feel it a great privilege to have been selected as one of two who are to respond on behalf of the gentlemen who have been invited here to-night, and I honestly wish that by some process of induction or otherwise I could worthily represent the feelings of thankfulness which, I am sure, are in the breasts, or some other part, of the persons of the gentlemen who have enjoyed the excellent dinner that has been set before them to-night. I fear, though, that had they known that I was to be selected as a speaker on their behalf they would almost have resented it; for they have heard, on no less an authority than the Postmaster-General, that my law is as bad as my electricity. I confess I shall go out of this room to-night a sadder and, I trust, a wiser man, determined by some process or other to endeavour to imbibe, if not a little more law here, a little more electricity, which may conduce to a higher standard, up to which I may direct my law. My excellent friend Dr. Hopkinson has spoken in kindly terms that there are many in this room whom I have met in combat. I have always liked to see them on my side, and when they were opposed I regarded it as a temporary misfortune as far as I was concerned. I confess I never knew before that I was going to join the society because I was an electrician. I was asked by a very distinguished electrician, no less a person than my friend Sir David Salomons, whether I would consent to become a member. I said, "I thought you only admitted great electricians." "Oh," he said, "we take duffers as well." (Laughter and applause.) On these terms I felt that there were some possibilities of my being not blackballed but elected. It is not for that reason only that I have a very great desire to improve my knowledge of electricity, and I think that if I were to dine here more frequently, to sit between Mr. Latimer Clark and Mr. Preece, that some secondary currents might possibly find their way into my miserably insulated body—perhaps I ought to say, my perfectly insulated body, so far as electrical ideas are concerned. Years ago I studied secondary batteries, or tried to, and I think they represent my constitution. My excellent friend Mr. Crompton told me that I was no good; I charged very well, but discharged much too rapidly. (Laughter and applause.) I am at the present time in a state of despondency, because not very long ago, while considering some of these abstract problems, I met Prof. Forbes, and I explained to him my condition. After looking at me very carefully he said, "You are wound the wrong way, you want re-winding." (Laughter and applause.) I am possessed by the hope that some subtle agency will possibly do something for me. I have thought that I might venture to ask for admission within these sacred portals. I hope that many of the guests on whose behalf I have spoken will follow my example. I can assure you that it has given us much pleasure to be here, and we shall be only too glad to be your guests on any future occasion.

Dr. SELLERS (America), in his speech, referred at considerable length to the project of utilising the waters of Niagara.

Mr. RAIKES, in proposing "The Institution of Electrical Engineers," pointed out that the Institution of Electrical Engineers then called the "Society of Telegraph Engineers," was founded in 1871. The total number of members of all classes in 1872 was 268. In the present year it was 1,738, an increase of 1,470. In 1872 there were only two "students" in the list, whereas now there were 102. The students generally were young men employed by companies and firms of one kind or other. They benefited by hearing the papers read at the ordinary meetings of the institution, but they had also a special organisation, and held meetings of their own. Sir David Salomons, a member of the council of the institution, had recently founded an exhibition for the benefit of the students. The exhibition was awarded, after a suitable examination conducted by the staff of one of the technical colleges. The institution had an invested fund of £2,300, and might now be considered as occupying an assured position. Referring to matters in which electrical engineering concerned our daily life, he recalled the system of block signals on railways, and the great advantage of synchronising time in the most distant parts of the kingdom, and thus securing one cardinal time. This was of enormous benefit in regulating all sorts of matters connected with daily life and ordinary commerce. It was to the electrical engineers that they owed their system of 120,000 miles of submarine cables, and within the limits of these islands 2,000,000 miles of telegraphic system. That did not, he believed, include the telephonic systems, but on this burning question he would say as little as he could; with the expiry of the telephone patents in the course of the next year or two, a fresh field would be opened for the inventive genius of electrical engineers.

The PRESIDENT briefly acknowledged the toast, after which the company separated.

## CORRESPONDENCE.

### The Electro-Deposition of Copper.

I would have been content to leave this matter to the judgment of your readers, having clearly set out eight points in which your objections to the process were in my opinion unfounded, and which eight points remain unanswered.

You, however, imply by your note in last week's issue, that my meaning was not clear to you, and I will therefore restate with greater fulness the points which dispose of your previous criticisms upon the process.

1. Your calculation of the current necessary was "practically ridiculous," because

(*a.*) You assumed 60 hours per week instead of the usual 156.

(*b.*) You assumed that the whole of the depositing goes on in one tank, which is, of course, out of the question.

By these two assumptions you arrived at the enormous figure of 287,620 ampères, a current which, if correct, would certainly be a serious objection in practical work.

The correct figure is somewhat less than 3,000 ampères, as appears clearly in Dr. Hopkinson's report from which you have quoted.

The following extract from *Nature* (January 26th, 1888, p. 303), endorsed by Dr. Gore in his well known book (p. 7), is further confirmation of my contention. "Messrs. Bolton at Widnes, and Messrs. Vivian, as well as Messrs. Lambert at Swansea, are each depositing 40 to 50 tons per week by currents [of] from 5,000 to 10,000 ampères."

2. Your calculation of the resistance of "the bath," founded upon the necessity of a current more than 90 times as great as that actually necessary, is consequently incorrect in the same degree; and the fact of your making this calculation shows distinctly that you contemplated the work being done entirely in one bath or on one circuit, which, I repeat, is practically out of the question.

3. The necessity for this enormous "bath" conceived by you therefore disappears in reality, and I may add that the size of the tanks in the Elmore process has never presented the slightest difficulty.

None of the "eminent scientists and authorities," quoted by you, have written a word that will support your contention that "20 tons per week would involve the use of enormous tanks worked under conditions that would be impossible except by a heavy outlay for plant and tank space.

4. As a proof of your wisdom in accepting my view as to the practical range of current-density, I would again refer you to Dr. Gore (p. 208), where he says, "the range of variation in these cases is from 0·82 to 10 ampères" [per square foot].

You add that you fail to see the force of my contention. It is this, that the weight of metal that can be deposited in a given time with a given tank plant is, *cæteris paribus*, proportional to the current density which is feasible, and therefore the higher current density in the Elmore process effects a corresponding economy in tank plant.

5. You have not been able to deny the correctness of my criticism.

6. Again, you do not deny my statement but rely upon a quotation from Mons. Fontaine's book, which applies to the state of the industry more than five years ago. Your quotation is now entirely misleading, for, as I stated, the cost of refining a ton of copper cannot be £12, inasmuch as the market price does not exceed £8.

7. I am glad that you disclaim any intention to reflect upon the quality of the articles produced by the Elmore process.

The belief expressed by me, as to the profit to be made in the manufacture of wire by this process, is founded upon facts which have already appeared in an article in your journal, and upon opinions expressed by manufacturers of many years' experience.

8. In confirmation of my statement that competent authorities had verified the correctness of the statements, which have been made with regard to the cost and quality of the articles manufactured, I enclose you a copy of the report, by publishing which you will oblige me.

I may mention that Messrs. Vigreux and Bourdon are professors at the Central School of Arts and Manufactures of France, and were respectively head and assistant engineers in the Mechanical and Electrical Section of the Paris Exhibition of 1889. Mons. Secretan's practical knowledge of the subject is beyond dispute.

With regard to your demand for a detailed statement of the cost of manufacture, the Elmore Company have, in the exercise of their undoubted right as manufacturers, objected to these figures being given by me.

**W. Stepney Rawson.**

*November 19th*, 1890.

### *Report of Mons. Eugene Secretan.*

[TRANSLATION.]

17, Boulevard Beausejour,
Paris, *October 15th*, 1890.

*To the President and Members of the Board of*
The French Elmore Company, London.

Gentlemen,—In accordance with what was agreed at the last board meeting, Messrs. Vigreux and Bourdon, members of the committee, and I, went to the factory at Leeds to inspect it, and to make ourselves definitely acquainted with the value of the Elmore process, and of the cost to manufacture by it.

My colleagues and I have been able to satisfy ourselves that the figures that were given to us were perfectly exact, and the experiments we made upon articles manufactured before us demonstrated to us in the most absolute manner the high qualities of the articles obtained by this process.

* The statement which accompanies this is prepared upon the supposition that at least 900 tons per month are made—an amount which it is easy to reach in a very short time.

The expenses set out in this statement are taken at the maximum, and cannot be exceeded, but, on the contrary, can be reduced when a definite project is prepared.

The receipts have been taken certainly at the minimum, as the prices calculated are based only upon very low figures, and below those which are currently quoted.

My colleagues and myself, as well as the very able technicas men who accompanied us, have no doubt that the Elmore process

* The statement referred to is a long and detailed technical report on the cost of production and prices to be realized.

will permit of the economic manufacture of articles which are sold at very high prices, and this would form a large revenue not included in our calculations.

Now, the above being well established, it is necessary to take immediate steps to commence work, and I therefore beg of you, Gentlemen, to take into consideration at the very first meeting of your board the following proposal, and to adopt it in principle.

However, you may find it is more prudent to decide for the moment on the construction of a factory capable of only turning out 300 tons per month, and this course I now propose.

I am certain that as soon as this, the first part of our programme, is executed, and the board can take stock of its success, they will not hesitate to give orders to obtain the necessary plant to increase the output.

To arrive at these results, of which there is not the least doubt, work must be undertaken. To work, plant and material in sufficient quantity are necessary, and I therefore beg the board to give me without delay the necessary instructions and means to enable me to proceed.

This being decided upon, one can, without rashness, predict a brilliant future to your company. What is here written is moreover a justification of the heading of the prospectus, calling the Elmore process "a revolution in the copper industry."

I beg of you to accept my high consideration,

The General Manager,

E. SECRETAN.

"After having read the above report we approve the contents, and we declare ourselves very satisfied with what we have seen at Leeds."

L. VIGREUX and C. BOURDON.

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The abstract of the specification of Mr. H. Wilde's patent of 1876, for electro-coppered iron rollers, which appeared in the last issue of the ELECTRICAL REVIEW, induces me, as one closely associated with Mr. Wilde in the development of his invention and its successful working, to bring under notice some facts connected with the history of the subject which may be of interest, and correct any wrong impression prevailing as to the value of the burnishing process described in the specification. The principal feature in Mr. Wilde's improvements in the electro-deposition of copper in cylindrical forms was the imparting a rapid rotatory motion to the electrolyte or depositing liquid in which the roller is immersed, in order that fresh particles of the electrolyte might be brought into contact with the electrodes. By this means powerful currents of electricity could be brought to bear upon small surfaces of metal, without detriment to the quality of the copper deposited, while the rate of the deposit is greatly accelerated. This improvement formed the subject of Mr. Wilde's patent of December, 1875, No. 4,515. The copper deposited by the new process was superior in tenacity and other qualities to that produced by any other metallurgical process, as was evident from the turnings off a cylinder, which had the ductility of well annealed copper wire, and could be reeled off during the process of turning in lengths of hundreds of feet. Great density was also given to the electro-copper cylinders by submitting them to the action of a steel burnishing roller, and when no special means were taken to secure adhesion between the metal surfaces, the iron and copper cylinders readily separated themselves by the milling or burnishing process. I have now before me a 400 feet length of a copper wire turning, and an electro-copper cylinder, 36 inches long, and 5 inches in diameter, produced in the manner described, 14 years ago.

As the production of separate copper cylinders was not the principal object Mr. Wilde desired to attain, but a compound roller of iron and copper inseparable from each other, as a substitute for the solid copper rollers used in calico printing, it was found that, by depositing one or more thin coatings of copper on the iron before the thicker or final coating, the internal friction of the copper surfaces caused perfect adhesion between the metals, so that the compound rollers would then withstand the heavy milling and burnishing to which they are subjected in some processes of engraving. Soon after the manufacture of these compound rollers was established it was found that milling of the separate coatings was an unnecessary process, and that the essential cause of the adhesion of the iron and copper surfaces was the separation of the internal coatings, which could be brought about either by exposing the newly-deposited copper to the action of the air, or by a temporary reversal of the electric current.

During the last 14 years these electro-copper rollers and cylinders have entered largely into the industries of the country for a variety of purposes, and thousands of them are manufactured annually by the Broughton Copper Company, Manchester, to whom Mr. Wilde disposed of his patent rights ten years ago. The rollers and cylinders have been exhibited by the company at several industrial exhibitions, including the Electrical Exhibition at the Crystal Palace in 1882, at which Elmore & Co. were also exhibitors of dynamos and electro-plating apparatus. The last of Mr. Wilde's patents expired in September last, so that the public are now at liberty to use whatever there is of value in them for the electro-deposition of copper cylinders and for other purposes. It may, therefore, be taken as conclusive that the art of producing electro-copper cylinders on a large scale and increasing the density of the copper by the process of milling and burnishing has been well known to the industrial world during the last 14 years, except to Mr. Elmore and the astute financiers who use the name and patents of Elmore to conjure with, and take advantage of the unbounded credulity of the general public in the possibilities of electricity.

**John Hill.**

16, St. Oswald's Grove, Harpurhey,
Manchester, *November 25th*, 1890.

P.S.—I am sending by parcel post small pieces of the wire turning and electro-copper cylinder referred to, which you are at liberty to make use of as you may think proper.—J. H.

[We have received the articles to which Mr. Hill refers in his postscript, and very interesting they are; we only hope that his evidence may be the means of opening the eyes of Elmore shareholders to the true value of the stock they hold.—EDS. ELEC. REV.].

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### Overhead Conductor Regulations.

It will interest your readers to know that two memorials have recently been forwarded to the Board of Trade upon the subject of the regulations relating to overhead conductors. The memorials, of which, at the request of members of the firms interested, I enclose copies, explain themselves.

**The Brush Electrical Engineering Company, Limited.**
R. PERCY SELLON, *Assistant Manager.*

*November 24th*, 1890.

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[COPY]

London, *November 6th*, 1890.

To the Right Hon. Sir EDWARD MICHAEL HICKS-BEACH, Bart., M.P., *President of the Board of Trade.*

Sir,—We, the undersigned companies, firms and persons, interested in the supply of electricity in the United Kingdom, beg respectfully to memorialise your Board with reference to regulation No. 9 of the regulations for the protection of the public safety, &c., prescribed by the Board of Trade under the provisions of the Electric Lighting Act of 1889.

With reference to this regulation, the undersigned beg leave to state that it is the general experience based upon numerous actual tests, that for pressure up to 2,000 volts, whether alternating or continuous current, a thickness of one-tenth of an inch of dielectric is unnecessary in conductors of small section.

For conductors having a relatively large sectional area, we are satisfied with the expediency of the Board of Trade requirements, but for conductors having a relatively small sectional area, the disproportion between the conductor and the insulation is so excessive, as not only to render the use of such conductors prohibitory in view of their high price, but actually dangerous in the presence of snow and high winds on account of the very large surface presented in proportion to the total weight of the conductor and its covering.

Four of the principal companies interested in this branch of work,

viz.: The Brush Electrical Engineering Company, Limited; Messrs. Crompton and Company, Limited; the India-Rubber and Gutta-Percha Company, Limited; and Messrs. Laing, Wharton and Down Construction Syndicate, Limited, were represented at the experiments carried out at the works of Messrs. Crompton and Company at Chelmsford, by your adviser, Major Cardew, and their representatives were so thoroughly convinced by these experiments of the reasonable character of their request for a modification of the existing rule, that the above-mentioned companies heard of the receipt by Messrs. Crompton and Company of the letter from the Board of Trade, dated May 30th, with the greatest astonishment and regret.

The undersigned beg leave, therefore, most respectfully to request the Board of Trade to give the decision therein communicated their favourable reconsideration, and to suggest that this rule may be modified in accordance with the following:—

Every high-pressure aerial conductor must be continuously insulated with a durable and efficient material, to be approved of by the Board of Trade, and to a thickness of not less than one-seventh part of the actual conductor diameter, in cases where the extreme difference of potential does not exceed 2,000 volts; but for all higher voltages this thickness must be increased in direct proportion to the increase in difference of potential.

In no case must the thickness of insulation be less than one-sixteenth of an inch, and the cables must have an insulation resistance of not less than one megohm per mile per volt of electromotive force when tested in water at 60° Fahr. (after immersion of at least 60 consecutive hours). This insulation must be further efficiently protected on the outside against injury or removal by abrasion. If this insulation or protection be wholly or partly metallic, it must be efficiently connected to earth, so, however, as not to cause undue disturbance to other electric lines or works by electrostatic induction or otherwise.

The undersigned are willing and anxious to conduct any additional tests which the Board of Trade may wish or suggest, in proof of the contentions herein stated.

The undersigned make these representations while fully recognising the necessity in the interests, not only of the public, but also of the electrical industry generally, that all overhead electric lines should be carried out in the safest possible manner.

We have the honour to be, Sir,

Your most obedient servants,

(Signed) THE BRUSH ELECTRICAL ENGINEERING COMPANY, LIMITED,

MESSRS. CROMPTON & CO., LIMITED,

THE INDIA-RUBBER AND GUTTA-PERCHA COMPANY, LIMITED,

THE LAING, WHARTON AND DOWN CONSTRUCTION SYNDICATE, LIMITED.

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[COPY]

London, *November 6th*, 1890.

To the RIGHT HON. SIR MICHAEL EDWARD HICKS-BEACH, Bart., M.P., *President of the Board of Trade.*

Sir,—We, the undersigned companies, firms, and persons interested in the supply of electricity in the United Kingdom, beg respectfully to memorialise your Board with reference to regulations No. 2 and 12 of regulations for the protection of the public safety, &c., prescribed by the Board of Trade under the provisions of the Electric Lighting Act of 1889.

With reference to these regulations the undersigned beg leave to bring before the Board the fact that in conjunction with overhead conductors having a small sectional area of copper, the use of suspending wires is not only necessary, but exceedingly dangerous to public safety, on account of the large surface presented to wind and snow, and the great strain put upon the supports.

It is admitted that this does not apply with so much force to the use of suspending wires with conductors of relatively large sectional area, but the undersigned are strongly of opinion that both in the interests of the electrical industry, and in those of public safety, it is advisable that overhead conductors up to a sectional area of hard-drawn copper, equivalent to 7 No. 16 S.W.G. should be run without suspending wires.

The undersigned beg leave, therefore, most respectfully to request the Board of Trade to give their favourable reconsideration to the foregoing regulations, and to suggest that they may be modified in accordance with the following:—

*Clause* 2. Every aerial conductor shall be attached to supports at intervals not exceeding 200 feet where the direction of the conductor is straight, or 150 feet where this direction is curved, or where the conductor makes a horizontal angle at the point of support. If suspending wires are used, as required in Clause 12, the above intervals may be increased to 250 feet and 200 feet respectively.

*Clause* 12. Every aerial high-pressure conductor shall be efficiently suspended by means of non-metallic ligaments to suspending wires, so that the weight of the conductor does not produce in it any sensible stress in the direction of its length, and the insulated conductors and suspending wires, where attached to supports, shall be in contact only with material of highly insulating quality, and shall be so attached and guarded, that in case they break away, it shall not be possible for them to fall away clear of the supports. Provided that where the aerial high-pressure conductor is equal to, or less than, 7 No. 16 S.W.G., the suspending wires shall not be compulsory if the conductor be of hard drawn copper, or other material of equal strength.

The undersigned are willing and anxious to conduct any tests which the Board of Trade may wish or suggest, in proof of the contentions herein stated.

The undersigned make these representations while fully recognising the necessity in the interests, not only of the public, but also of the electrical industry generally, that all overhead electric lines should be carried out in the safest possible manner.

We have the honour to be, Sir,

Your obedient servants,

(Signed) THE BRUSH ELECTRICAL ENGINEERING COMPANY, LIMITED.

MESSRS. CROMPTON & CO., LIMITED.

THE LAING, WHARTON & DOWN CONSTRUCTION SYNDICATE, LIMITED.

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### Single-Cord Telephone Switchboards

We much regret that by an oversight we have not replied sooner to the criticism which appeared in your issue of the 31st October of a particular pattern of single cord board by the Western Electric Company, through Mr. Kingsbury. This board, described in your issue of the 24th October, was selected as being the simplest pattern; it is one of large numbers we have made, to sample received, in which accessibility for adjustment and repair, and certainty of action of the indicator drops, are most considered. Mr. Kingsbury has fallen into the error of assuming that this is the only pattern of board made; the dimensions he gives are wrong, a complete 150 line board has a width of 6 feet 2 inches, and not of 15 feet, as he appears to assert. However desirable compactness may be, accessiblity must be considered; still, if we make use of the *small* annunciators shown on the W. E. board 31st October, the S. C. board will be quite as compact.

For the moment, assuming Mr. Kingsbury's list of connecting and disconnecting operations to be correct, it should be noted that the W. E. operations, even when using speaking and ringing keys, need seven movements in all; the single cord board criticised, requires the same number of movements *without* special speaking and ringing keys, but *the movements are reduced to four*, for connecting and disconnecting two subscribers, if these special keys, or their equivalent, are used. Such S. C. boards with small annunciators, and with special apparatus by which only four operations are needed, we are ready to supply.

**Telegraph Manufacturing Company, Limited.**

*November 25th*, 1890.

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### High-handed Proceedings—(*continued*).

We have again been requested to insert the following correspondence, but in future we must either summarise the letters or omit them altogether.

Glasgow, *November 18th*, 1890.

Wm. Alex. Smith, Esq.

Dear Sir,—I learn from Mr. Laid, law stationer, St. Vincent Street, and Mr. Woolfield, Buchanan Street, that you and Mr. Smith, the secretary of the National Telephone Company, called to buy two of my telephones "for export." It seems a waste of money to offer Mr. Woolfield double the price when, by applying to me, you can get a ship load at even less money. If you will give me your marks and numbers, with shipping port, I shall be very pleased indeed to take your order, and as I have nearly 2,000 lying in the Rue Caumartin, Paris, you need not have to wait long for them. Of course you are well aware that these cannot be introduced into this country as a sale till 9th December, but as you represent the National Telephone Company here that is a difficulty that need not stand in our way. You are aware in March last you and Col.

Jackson gave me an order for some which were delivered within 48 hours from Paris, and further, I may say they will be as much superior to your present telephones as Madame Patti's voice is to that of a broken-winded foxhound. May I expect a report from your engineer soon on the Lacombe cell which you asked from me.

Yours truly,
A. E. MUIRHEAD.

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6, South Hanover Street, Glasgow,
18*th November*, 1890.

A. Erskine Muirhead, Esq.,
Crossmyloof.

Dear Sir,—Your favour of this date has just reached me. I observe it is addressed to me as "Chairman of the Local Board," although I have informed you some time ago that for years no such Board has existed.

You have been incorrectly informed that Mr. Smith and I called on the parties named by you.

I have not seen any telephone from you which have not been tested by us long before I heard of your having anything to do with telephones. As to the efficiency of such telephones, you will excuse me when I say I am in a better position than you are to give an opinion.

The cell which you asked me to test for you has not yet been reported upon, but as soon as I do get a report of it it shall be communicated to you. As far as I can judge of it, it, like the other appliances submitted by you, are modifications of forms well-known to us for years.

Yours respectfully,
WM. ALEX. SMITH.

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Glasgow, *November* 19*th*, 1890.

Wm. Alexr. Smith, Esq.

Dear Sir,—I have yours of 18th. I called at shop, and as it was re-asserted that you were the person that called to buy the telephones, I can only ask that you will accept my apology and record it as another extraordinary case of mistaken identity. It is, moreover, very odd that the persons calling should say that by exposing those telephones for sale the shopkeeper was placing himself in a position in which the N. T. Company could claim damages, so it might be well if you consult your secretary and find some one has been acting for you to have it put a stop to, as you are aware that it is perfectly legal for anyone to offer (1) a telephone for sale for export; (2) to sell a telephone that does not infringe the patents of the N. T. Company. As regards your third paragraph *re* the efficiency of the "Ader" and "Berthon" telephones compared with the one in use by the N. T. Company, seeing both of us have very high opinions of our own judgment, I would suggest that if you really want an unbiassed opinion on the merits of the telephones, and to have the matter settled *you* will at hazard name a dozen members of telephones from the Paris Exchange, the editor of the *Herald* or *Citizen* will name 12 from the Glasgow Exchange. Those instruments as they stand will be conveyed to Glasgow and submitted to tests as they stand, not to be in any way touched. You can name six of your own subscribers, and I will name other six, or we can take them also at hazard, and ask them to report the results. I will use the Lacombe cells, of which you ask a sample, for trial. As regards the Kilmarnock affair, seeing we are going to fight a more serious battle, I will again make an offer to show your engineer the four telephones there, and trust if they are what I represent them to be, that you will apologise to Mr. Richmond. If they are infringements of your patent, then by all means proceed with your action; however, you will find them what I say they are, and I beseech you to ask your company to leave off the *rôle* of private detective, as it requires a capacity they seem to lack. I need not again remind you I am running bronze wires in the principal centres in Scotland, England, and North of Ireland, to which I am fixing "Ader" and "Berthon" telephones. After the 9th December, no microphone will be used at that date, as the "Ader" receiver is quite ample for any distance below 20 miles; but I again offer you a list of those lines, and an order to your engineer in the respective districts to inspect them, and thereby prevent a massacre of some of your *employés*, who might force their way in to see the telephones uninvited.

A. ERSKINE MUIRHEAD.

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The National Telephone Company, Limited,
Glasgow Offices, Royal Exchange Buildings,
21*st November*, 1890.

A. E. Muirhead, Esq.

Dear Sir,—I am directed by Mr. W. A. Smith to acknowledge receipt of yours of 19th inst., and to say that he has nothing to add to his letter in regard to the first portion of what you say.

I have to thank you for renewing your offer to allow our engineer to inspect the telephones erected by you, and shall feel obliged by your forwarding the necessary permission to this office, as well as orders to our engineer to inspect telephones you have erected in other parts of the country.

Yours truly,
D. JOHNTONE SMITH,
*District Secretary.*

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Glasgow, *November* 21*st*, 1890.

Mr. D. Johnstone Smith,
Secretary National Telephone
Company, Limited, Glasgow.

Dear Sir,—A very singular incident has happened, viz., that two gentlemen, thought to be Mr. W. A. Smith and yourself, went into Mr. Woolfield's shop in Buchanan Street, where one of my telephones was exposed in the window, with the enclosed card fixed to it. A very fancy price was offered for a pair, but as Mr. Woolfield could not sell them till 10th December, no business resulted, but the mysterious strangers then gave Mr. Woolfield to understand that by exposing those, even for export, he was doing an act that would bring the N.T. Company on him for damages. As you are the recognised chief of the N.T. Company in this city, perhaps you may see fit to disclaim all knowledge on your part, and that of the N.T. Company, of what I hold to be an interference with the liberty of the subject. As you are, perhaps, well aware, the Caledonian Railway Company's telegraph have at least a dozen different types of those French telephones in their possession. If you are not aware, I now take this opportunity to say I am quite at liberty to advise you of the fact, so that if the N.T. Company think they have a legal right to dictate to the Caledonian Railway for being in possession of those telephones, they can try it. It is patent to everyone that the N.T. Company have in this country tried to fill the vacancy left by the Society of Jesus, in the department of espionage and tyranny.

The S.J. had at least the credit of doing anything, however bad, *well*. Their staff contained the best men in every department. I leave it to you to say if yours is up to this standard. You may think it odd that I should insist in having this matter cleared up. I want to show Mr. Woolfield that I have not put him in a false position by asking him to do something that was illegal. I trust you will leave a reply to this, addressed to me at the bar of Royal Exchange, which I will at once show to Mr. Woolfield.

Yours, &c.,
A. ERSKINE MUIRHEAD.

I may add that a proof of circular, and also the advertisement now appearing in the *Times*, *Standard*,

*Daily Telegraph, Herald, Scotsman, Citizen, News and Scottish Leader*, were submitted to your London office before insertion.

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The National Telephone Company, Limited,
Glasgow Offices, Royal Exchange Buildings.
21*st November*, 1890.

A. E. Muirhead, Esq.

Dear Sir,—I beg to acknowledge receipt of your letter of this date, but regret that I do not see my way to enter into any correspondence regarding this.

Yours truly,

D. JOHNSTONE SMITH,
*District Secretary.*
*Per* J. D. W.

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Glasgow, *November* 24*th*. 1890.

Wm. Alex. Smith, Esq.,
National Telephone Company's Office,
Glasgow.

Dear Sir,—As you have at least always replied to me, I cannot be outdone by you in politeness. I now beg to enclose order on Mr. J. Richmond to allow your Mr. Aitken to inspect telephones. As regards Woolfield's affair, the "Flying Dutchman," Wandering Jew, or the German Baron must have paid our city a visit. As regards giving your engineer an order to inspect the other lines I am erecting in various parts of the country, it would (1) simply be impossible for him to overtake them before 10th December, as they are numerous, and are scattered over the country between Inverness and Bristol; (2) and, further, when your company came across Dr. Kelly's wire you were able then to offer him terms that induced him to take your telephone, though I hear that he may change his mind again, so you must excuse me declining to show you my hand when your company are so ready to take advantage of such information.

Your truly,

A. ERSKINE MUIRHEAD.

I shall be glad to hear if you have yet tested the Lacombe cell.

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Glasgow, *November* 24*th*, 1890.

Mr. D. Johnstone Smith,
Secretary National Telephone Company,
Glasgow.

Dear Sir,—Your note of 21st is duly to hand. I shall leave it to others to say whether it is a satisfactory reply to my note of 21st.

A. ERSKINE MUIRHEAD.

I have sent your London office a copy proof of enclosed circular. I may leave for London before I have their reply. If they want to see me they can address me at St. Pancras Hotel.

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6, South Hanover Street, Glasgow,
24*th November*, 1890.

A. Erskine Muirhead, Esq.,
Crossmyloof.

Dear Sir,—I am directed by Mr. Wm. Alex. Smith to acknowledge receipt of your favour of this date, enclosing order to inspect the instruments erected at Mr. Richmond's, for which he desires to thank you.

He takes good note that you now withdraw from your offer to give similar facilities to the telephone engineers in other parts of the country.

The report on the Lacombe cell is fairly satisfactory, but, of course, its durability can only be tested after a year or two's experience of the same.

Yours faithfully,

D. CAMPBELL.

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**Telephonic Research.**

I suppose it has also seemed peculiar to you that none of the text-books, &c., on telephones state the source from which the information is derived that Mr. Yeates, of Dublin, experimented with the Reis telephone, and placed a drop of water between the electrodes. To-day, while going through a mechanical magazine, I noticed an article which is very suggestive, because it says that the *Dublin Medical Press* (presumably of 1864) contains a description of experiments with an acoustic telegraph (presumably Reis's), and says that a membrane at the *receiving* station was thrown into vibrations corresponding to the vibrations of the membrane at the transmitting station. I enclose the article (in German) just as it appears in journal found by me :—

*Zeitschrift des Architecten Vereins für das Königreich Hannover*, A.D., 1866, Vol. XII., page 147.

Neues System A Rustischen Telegraphie. Die *Dublin Medical Press* veröffentlicht einen Artikel über diesen neuen Apparat welcher gestattet die Töne der menschlichen Stimme nach einem entfernten Orte zu übertragen. Man spricht in ein Rohr hinein nahe welchem eine Membrane angespannt ist deren Schwingungen durch den leitenden Draht auf eine *gleiche* Membrane an der Endstation übertragen werden. Durch die gleichen Schwingungen wird derselbe Ton hervorgebracht und so soll es möglich sein in der That mit einem anderen Welttheile ein Gespräch zu führen.

Article said to be taken from *Nouvelles Annales de la Construction*, 1864, January to September, page 39.

I am not at present in a position to consult the *Dublin Medical Press* (it does not appear to be a widely-disseminated journal, else we would have heard of it ere this). I suppose you will consider the matter of sufficient importance to consult the *Dublin Medical Press*, and give what it states in your Journal? I notice that someone has brought up the *Didaskalia* as being a new thing. I trust I'm not in same boat. Anyhow, the article in German journal (copied from French journal) ought to settle question that Reis had in view transmission of articulate speech. In this I'm a follower of Prof. S. P. Thompson.

A. M Tanner.

Berne, *November* 21*st*, 1890.

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**Australian Cables.**—The Hon. John Gavan Duffy, Postmaster-General to the new Cabinet of Victoria, has expressed himself in favour of the cable guarantee, notwithstanding the refusal of Queensland and New Zealand to bear a share.

Public opinion is gradually beginning to assert itself in the mother country as to the desirability of a direct cable from Canada to Australia, says the *Toronto Empire* of November 17th. Readers are doubtless familiar with the discussion which took place in the English Press this summer on this question, and the timely action of Mr. Sanford Fleming, impressing the advantages of a Pacific cable, has already had important bearings. The great shipping agency, Lloyd's, has taken a decided stand in the matter, as the following extract from a letter received by Mr. Fleming to-day from Mr. H. M. Hozier, secretary of that body, shows : —I ought to inform you that my committee have personally drawn the attention of the Prime Minister in this country and of the Chancellor of the Exchequer to the necessity of an alternative telegraphic route to Australia and the East by means of a telegraphic cable across the Pacific, and I am sure that my committee will be most happy to bring this matter forward and give it their assistance in every way in their power on all occasions.